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ABSTRACT

One of the objectives of the Nebraska Interactive Cable Project, an investigation of the educational potential of interactive cable, was to develop a design and production process for interactive cable/videotex instruction. The first part of the project involved the adaptation of three existing correspondence courses on marriage and the family, comparative modern governments, and business writing for use on INDAX, an interactive coaxial cable system developed by Cox Cable Communications. Each course was developed under a team which included a project manager, graphic design specialist, independent study specialist, and faculty member from the University of Nebraska-Lincoln. Based on this course development experience, this handbook provides a summary of videotex technology and its educational applications, a detailed discussion of the development process for videotex instruction, and cost and manpower data relative to educational videotex development. Chapters cover: (1) videotex, teletext, and education; (2) instructional development for videotex; (3) flowcharting; (4) scripting; (5) graphic design/frame development; (6) computer programing; and (7) time and cost considerations. Examples of INDAX frames from the three correspondence courses are provided. Also presented are a 31-item glossary, a section of an instructional sequence flowchart from the Nebraska project, and a 23-item bibliography. It is noted that the second part of the Nebraska project will focus on videotex evaluation and the development of short, stand-alone videotex segments to be delivered via Cox's INDAX system. (ESR)

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DESIGNING AND PRODUCING VIDEOTEX INSTRUCTION

A Producer's Handbook

by

Gwen Nugent, Assistant Project Director

P.J. Peters, Graphic Artist

Lee Rockwell, Project Director

Interactive Cable Television

A Public/Instructional Television
Research, Development, and Demonstration Project
of the University of Nebraska-Lincoln's
Station KUON-TV and Division of Continuing Studies

P.O. Box 83111

Lincoln, Nebraska 68501

April 15, 1983

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The Nebraska Interactive Cable Project is a research and demonstration project to investigate the potential of interactive cable. Funded by the Corporation for Public Broadcasting and Cox Cable Communications, Inc., the project is a cooperative effort of the University of Nebraska-Lincoln's Station KUON-TV and Division of Continuing Studies. As Project Director, Lee Rockwell coordinated the activities of the funding agencies and the educational units. Phil Rubin, Chief Scientist of the Corporation for Public Broadcasting's Office of Science and Technology, served as the CPB liaison. Walt Schaar, Director of INDAX Services Administration for Cox, served as that organization's primary liaison for programming and business management. Monty McMahon, Director of Independent Studies, coordinated the Division of Continuing Studies' activities in the project.

INDAX segments were developed by course teams working under the direction of Gwen Nugent, Assistant Project Director. P.J. Peters, the project's graphic artist, also served as a member of all course teams. Other members were J. Allen Williams, Jr., content specialist, and Marie Anne Barber, specialist in correspondence education, for the Marriage and Family course; Lou Picard and Ruth Grubel, content specialists, and Marv Van Kekerix, specialist in correspondence education, for the Political Science course; and Jerry Parsons, content specialist, and David Allen, specialist in correspondence education, for the Business Writing course.

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INTRODUCTION

THE NEBRASKA INTERACTIVE CABLE PROJECT

The Nebraska Interactive Cable Project began in March, 1982, as a cooperative effort of the University of Nebraska-Lincoln's Station KUON-TV and Division of Continuing Studies. Funded by Cox Cable Communications of Atlanta, Georgia, and the Corporation for Public Broadcasting, the project's purpose was to investigate the educational potential of interactive cable.

In support of the primary project purpose, several objectives were established:

-- To develop a series of interactive courses of instruction for Cox's interactive cable system (INDAX) based on existing independent study-by-correspondence courses;

-- To develop a process which uses the two-way capability for computer-managed instruction (student testing and record-keeping functions); and

-- To develop a design and production process for instructional/educational uses of interactive cable television and to begin to refine and streamline this process.

To achieve this purpose, Cox's INDAX was used for project development and implementation. INDAX uses coaxial cable to connect viewers directly to a central computer. The full two-way interactive capability of INDAX was used, allowing the student to use a keypad (similar in appearance to a remote control unit and shown in Figure 1) to make choices. The user's request is sent to a Tandem mainframe computer

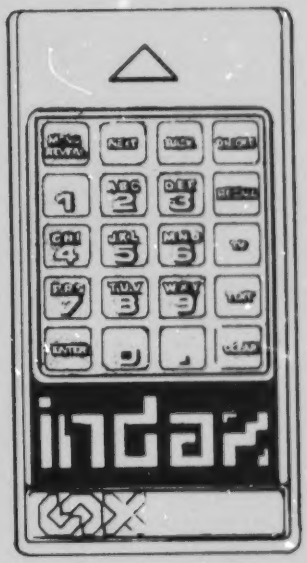


Figure 1: Remote Control Unit (Reduced in Size)

located in the cable operator's headquarters. This computer responds by sending the appropriate information downstream to the user.

One of the first project functions was the development of a list of educational specifications by the Nebraska staff. This list identified certain functions necessary to provide effective computer-based instruction. It included both management and instructional requirements, such as branching, response processing and record-keeping, and session-to-session continuity. This list was submitted to Cox, who developed the software to computerize identified functions. This software is believed to represent the most comprehensive package for instructional applications of two-way interactive cable currently in existence, and its implementation is directly related to the project objective of using cable's two-way capability for computer-managed instruction.

Components of three existing independent study-by-correspondence courses were adapted to the INDAX system. The three courses

selected were Marriage and the Family, Comparative Modern Governments and Business Writing. Course development teams were established for each course and included a project manager, graphic design specialist, independent study specialist and faculty member. In determining the role INDAX would play, a major consideration was how an interactive instructional component could strengthen the existing print-based course. Approximately 3,000 individual text and graphic frames were developed, and segments included simulations, games, tutorials, glossaries and testing sequences.

Production equipment was purchased or placed at the Nebraska facility to develop frames, to input programming and to facilitate data communication between the Lincoln staff and INDAX facilities in Omaha. The equipment allows all graphic development, transfer of graphics by modem and telephone line to the head-end INDAX computer, recall of graphics as seen on INDAX, correction of graphics in the INDAX system, and creation of branching to provide full instructional capability. In short, although the project staff is separated from the Omaha INDAX facilities by more than 60 miles, the University of Nebraska-Lincoln is equipped with a complete communication system to facilitate project development.

Phase I of the project concluded March 15, 1982. Phase II, a cooperative effort of KUON-TV and San Diego State University's public television station KPBS, has been funded by CPB and will run through March, 1984. Phase II builds on the earlier research and development of both institutions and will focus on more extensive evaluation and the development of short, stand-alone videotex segments to be delivered via Cox's INDAX system.

PURPOSE OF THIS HANDBOOK

This handbook addresses the final project objective of Phase I--to develop a design and production process for interactive cable instruction. The purpose of this publication is to provide:

(1) A summary of videotex technology and its educational applications;

(2) A detailed discussion of the development process for videotex instruction; and

(3) Cost and manpower data relative to educational videotex development.

The first four chapters provide overviews of the technology and development process and discuss flowcharting and scripting. Chapters five and six focus on the production aspects of frame development and computer programming. The final chapter presents cost and time data and is followed by a glossary of key terms. Discussions center around the experiences and procedures developed by the Nebraska project for development of videotex materials for delivery via INDAX.

General principles and procedures, however, will transfer to any videotex format. There are, however, some specific areas where transfer to other videotex systems is not automatic. First, the software and authoring system prepared by Cox is specific to INDAX. It will not work on another system without reprogramming, which would require a considerable time investment. Another potential area of difference is graphic development and display, which will be discussed in greater detail at the end of chapter five, "Graphic Design/Frame Development."

CHAPTER ONE

VIDEOTEX, TELETEXT, AND EDUCATION

OVERVIEW OF THE TECHNOLOGY

The merger of developments in video and computing has led to a new technology that has the potential to change the way people currently receive information. Grouped within the generic terminology of teletext and videotex, its distinctive feature is not the individual technical elements, but the assembly of a total system comprising information banks, indexing structures, computer and communications hardware and software, and systems management. Although the role of the technology is now emerging, a recent study conducted by the Institute for the Future predicts that almost half of US households will be using videotex services by the end of this century (Tydeman, Lipinski, Adler, Nyhan, & Zwimpfer, 1982, p. 86).

Both videotex and teletext systems require that the viewer have a television set equipped with a special decoder, which translates the data into a television display. If videotex signals are carried via phone lines, the user must also have a modem, which interfaces with phone lines. In addition, he/she may also have to pay long distance phone charges. If videotex signals are carried via two-way cable, users are typically charged a per month usage fee, which can range from $5 to $75 a month, depending on the type of services offered.

Although there are similarities between teletext and videotex technologies, there are also significant differences. Videotex is two-way transmission of information, either through coaxial cable or

telephone lines. Two-way transmission means that the user's request is sent upstream to a large computer, and the information requested is in turn sent downstream to the user. Videotex can be used for basic services, such as information retrieval, or it can be employed for higher-level applications such as transactional services. On one level, a user can search out entertainment opportunities and airline schedules by simply working through a series of indexes or menus until locating the desired information. At a more advanced level, customers can actually pay bills, transfer funds or purchase goods by making selections through their keypad.

Unlike videotex, teletext transmits information via the vertical blanking interval of a TV signal, the unused lines currently being used to send closed captions and test data. This digital data is fed into a decoder attached to the TV set and stored in a buffer memory. When a user keys in the number of a particular page, the page is transferred to the screen and remains until a new page is requested. The advantage of teletext is that it essentially gets a "free ride" on the broadcast signal. The disadvantage is the small number of frames or pages that can be stored (generally 100-200 pages) and the fact that the system is one-way. It does not provide the full two-way interactivity of videotex.

Thus, one critical difference between videotex and teletext is that videotex involves two-way transmission of information while teletext is one-way. Teletext data is cycled in a broadcast mode, and limited information can be stored. Videotex users have direct access to a large computer, and the amount of information available is limited only by its memory and processing features.

Videotex and teletext systems both present text and colored graphics but differ in the way graphics are developed and presented. Some systems utilize an alphamosaic approach in which the graphic appears as if it were constructed of individual tiles. The result is a rather crude representation with no curved or diagonal lines. Another system is alphageometric, where graphics are assembled from computer-stored geometric patterns, which include circles and arcs. The alphageometric system, by offering smooth and high resolution graphics, allows a closer representation to actual objects and, therefore, more flexibility to the graphic designer.

INSTRUCTIONAL ADVANTAGES AND LIMITATIONS

During the 1960s, television was praised as a medium that could revolutionize instruction by providing instructional experiences that could not be duplicated in the classroom. Although there is no question as to the instructional capabilities of television, some will argue that its full potential has never been realized. Disadvantages cited are its lack of individualization and the fact that broadcast television is essentially a passive medium.

During the 1980s the scenario has changed, and it is now the computer that is being heralded as the revolutionary instructional tool. The computer is having a pervasive influence on society, as evidenced by Time magazine's designation of the computer as 1982's "Man of the Year." In contrast to television, the computer is an interactive medium and is ideal for individualization and active learner involvement.

Videotex is basically a computer-based system, but its integration

with television delivery and cable distribution makes it a hybrid of the two technologies. Although videotex was developed with business interests in mind, the nature of the medium, and particularly the two-way transmission of information, provides a unique opportunity for the delivery of effective instruction. Videotex offers several advantages for instruction:

1. The interactive nature of the medium allows students to become more than passive receivers of information. They can become actively involved in the learning process.
2. The instruction is under learner control; it appears and is accessed depending on the response or choice of the learner.
3. The interactive nature of the medium provides individualization. Students may spend as much or as little time needed to work through the instruction and receive feedback appropriate to their needs. A better match between learner style and method of instruction is thus facilitated.
4. The system can be used at home. The learner will be able to access and interact with a mainframe computer immediately on a 24-hour basis.
5. The system provides full-color graphics to supplement presentation of textual information.
6. The system is easily understood by untrained users. It is a system for noncomputing or nonelectronic specialists.
7. Consumer use can be low cost, especially through cable delivery. Display is usually through a home TV set with the added cost only of a decoder and usually a service fee.
8. Videotex has the potential to reach a large audience

(typically associated with broadcast television) and still provide an individualized learning experience for each.

The decision to develop videotex instruction should be based on a careful analysis of the strengths and limitations of the medium. The interactive capabilities of videotex, coupled with its graphic capabilities and distribution patterns, are strong pluses. One should not lose sight, however, of the medium's limitations:

1. Large amounts of text do not transfer well. Videotex is not a good way to read continuous print pages.
2. Current systems do not have motion capabilities.
3. Some videotex systems do not have keyboards and will not accept constructed responses.
4. Alphamosaic graphics are simplistic in nature and can only serve as a representation of an object.
5. Some systems have limitations which restrict the level of computer-based instruction that can be provided.

EDUCATIONAL APPLICATIONS

Most of the current videotex literature deals with hardware systems and pilot projects. It is long on promises, potentials and plans and short on actual applications, user reactions and hard data. Nevertheless, educational applications of this tehnology have been evidenced by some exploratory projects. Because the number of true interactive videotex experiments is small, this section will include both videotex and teletext educational trials.

Early Videotex Trials

Several videotex projects have utilized Telidon, a Canadian-based

technology. One project tested a Telidon supplement to a traditional high school correspondence study course. General achievement comparisons between the videotex-supplemented course, the traditional correspondence course, and in-school instruction showed no differences. The project concluded that the "instruction utilizing Telidon was as effective as traditional correspondence instruction and in-school instruction" (Montgomerie, 1982, p.2). Self-reports by students indicated that they spent approximately 20-30 minutes on each videotex lesson and that they liked the graphics, immediate feedback and self-pacing. Another major finding was that the course represented a very primitive form of computer-based learning. Although individualized feedback was provided, there was no grading capability. Students received scores by mail.

Other field trials have been conducted through TV Ontario's Telidon and Education Project, and one experiment reported a direct comparison of videotex instruction versus traditional classroom instruction. Results showed an interaction between level of the student (general versus advanced) and method of presentation. The general level students performed better with teacher-led instruction, while there was no difference between traditional instruction and videotex instruction for the advanced students (Trueman, 1982).

Although achievement results of this project may seem uninspiring, what is of note is the delivery system. The data base was located 250 miles from the high school where the experiment took place. Communication with the data base was either by direct phone line or through Bell Canada's Datapac Network. The project confirms the capability to provide instruction to remote locations through a videotex network.

Another videotex system that utilizes phone line transmission is Britain's Prestel, which was developed by the British Post Office in 1970-71. Prestel currently contains about 185,000 pages (Real, 1981), but there is no education category on the main menu. A project to discover what the educational user felt were the advantages and disadvantages of the system, with a view to influence its development to education's benefit, was begun in 1980 by Britain's Council for Educational Technology (CET). Thirty-two Prestel terminals were placed in a variety of educational institutions. Results showed that most of the trial users were excited by the system's potential, but two disadvantages were cited. Information in the Prestel data base was not appropriate to the majority of subject areas in the school curriculum, and operating costs were high (Thompson, 1982).

One way CET views cutting through the operating costs, and particularly the phone line charges, is the addition of a microcomputer. A microcomputer would allow local storage of videotex pages and hard copy of pages via the microcomputer's printer. To explore this potential, in 1981 CET initiated its Telesoftware Project. This project aimed to develop a process allowing the user to access a computer program stored on Prestel through a microcomputer equipped with a suitable modem. Software was also developed to make the microcomputer emulate the Prestel terminal and decode the telesoftware. The programs can be used as soon as they have been downloaded or stored on disk for future use (CET Information Sheet #2).

Another interesting videotex experiment was the Channel 2000 Project in Columbus, Ohio, which also used phone network distribution. Although the project's emphasis was on the access of library

information, certain language and math programs for children were included in the data base and received heavy usage. Project results showed, however, that 35% of the sample agreed there were too many technical problems with the system, and researchers acknowledged this was a negative influence on users' evaluations (OCLC, 1981).

In contrast to phone line distribution, perhaps the best known application of two-way cable is QUBE, which was begun in 1977 in Columbus, Ohio, by Warner Amex Cable Communications. "QUBE is more properly described, however, as a polling response system rather than true videotex" (Tydeman, Kipinski, Adler, Nyhan, & Zwimpfer, 1982, p. 42). The system permits individual users to register answers to broadcast questions. Cumulative results are then computer-tabulated and displayed so users may know the percentage of viewers responding to each choice.

The first educational application of Cox's INDAX system was conducted in San Diego by KPBS-TV. Because the two-way system was not fully developed at that time, the project utilized the one-way capability of the INDAX system, which has certain branching and program size restrictions. This experiment involved an INDAX supplement to a conventional television series, "Understanding Your Investments." The INDAX segment included background information, timely updated market and stock information, testing sequences and glossaries. Evaluation of the project showed an overall favorable rating to the videotex supplement services. Users were highly complimentary of both the present state and future potential of videotex supplements to telecourses. However, the findings also showed that the "when you want

it" advantage of videotex is lost when it supplements a telecourse. The telecourse-and-videotex combination retains a major disadvantage of broadcast media and reduces the impact of the videotex medium (Goodfriend, Bamberger, Dozier, & Witherspoon, 1982).

Early Teletext Trials

In contrast to these videotex trials, one of the earliest teletext experiments was the elementary and high school learning programs developed through KCET's (Los Angeles) Teletext Services. Using the Antiope System, interactivity was achieved through use of the reveal function and through manual branching techniques. In using the reveal function, a student is presented with a question and covertly determines his/her answer. When the reveal button is pushed, the correct answer appears on the screen. The branching capability makes use of page numbers noted by each choice on a menu or decision frame. The student keys in the page number of his or her response and the page appears, providing feedback as to the correctness. A variety of teletext materials were offered. Some materials supplemented in-school television programs such as THINKABOUT and MEASUREMETRICS. Others provided interactive learning quizzes to supplement and complement the regular school curriculum. Another area of program development was an information service to teachers to facilitate ITV use.

KCET Project evaluations showed that teachers felt the materials were highly motivational and offered valuable enrichment to the regular school curriculum. Interestingly, results showed a preference for use in small groups, as opposed to entire class or individual settings. Small groups were found to promote a level of discussion and student interaction not possible in the other two settings.

Students also responded positively to the teletext service, reacting favorably to the graphics, the interactivity and the timeliness. Disadvantages cited were largely related to technical problems, including excessive access times (Goldman, 1982; Goldman, Gordon, Craig & Gingras, 1982).

Another teletext experiment using Antiope equipment was conducted by WGBH (Boston). The station tested an educational news service for secondary schools and placed twenty decoders at local museums, public high schools, and department stores. Preliminary results indicate that teletext was very appealing to the target audience and that the interactivity and immediacy of the information stimulated interest and motivated reading. Similar to the KCET experiment, results also showed that small group use provided a unique opportunity for group interaction and discussion.

CONCLUSIONS

What, if any, conclusions, can be drawn from this myriad of experiments about using this new technology for educational purposes? Because the number of experiments is small and because of the quasi-experimental design of many of the evaluations, the conclusions must be regarded as tentative and subjective. Nevertheless, they are presented as a beginning point for discussion and further substantiation in this emerging field:

1. Effective instruction can be delivered via videotex or teletext, and students do learn from this medium. However, the sophistication of the system influences the quality of interactive instruction that can be delivered.

2. The educational applications for the medium are broadly based. It can be used for:

   a. Correspondence study (Montgomerie, 1982);

   b. In-class instruction (Trueman, 1982);

   c. At-home instruction or classroom instruction supplement (OCLC, 1981; Goldman, 1982);

   d. Telecourse supplement (Goldman, 1982; Goodfriend, et al., 1982); and

   e. Delivery of up-to-date educational and current event information (Goldman, et al., 1982)

3. Videotex/teletext's television display and perceived relationship to video/arcade games make it a highly motivational delivery medium for younger audiences.

4. Downloading of computer programming may be an efficient, low-cost adjunct to videotex distribution.

5. A telecourse and videotex/teletext combination can reduce the "on-demand" advantage of the videotex/teletext medium.

6. Consistent technical problems influence viewer's evaluation of the technology and have the potential to reduce usage.

CHAPTER 2

OVERVIEW OF INSTRUCTIONAL DEVELOPMENT FOR VIDEOTEX

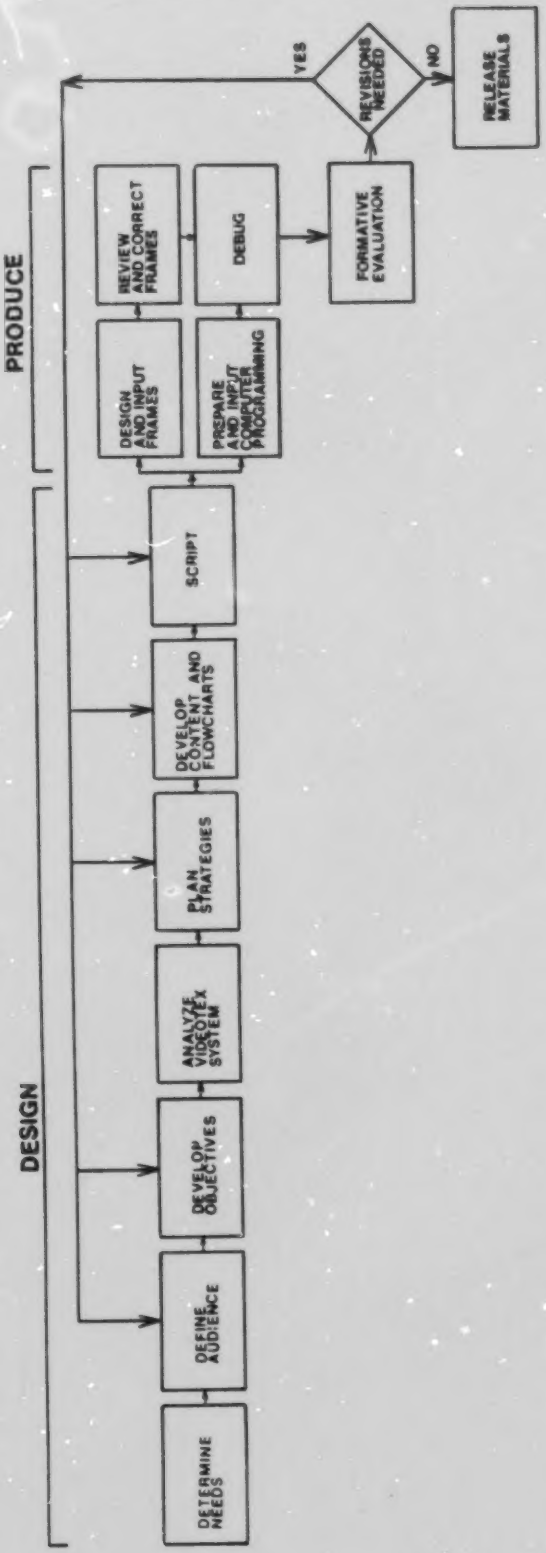
THE DEVELOPMENT PROCESS

Because there are many steps in the development process requiring varied expertise, the Nebraska project uses a team approach. Figure 2 graphically depicts the design, production, and evaluation model developed and used by the Nebraska project. This chapter presents an overview of this process in order to provide a clear understanding of the steps involved and their interrelationship. Subsequent chapters are detailed explanations of specific functions.

Developing videotex instruction involves many of the same steps as designing any media product. There should be a preliminary needs analysis to identify exactly what learner needs should be addressed through an instructional product. An audience analysis is also necessary, as well as the development of goals and objectives. One difference, however, is that design models generally include a step known as "select media." Since this manual is concerned only with videotex instruction, this step has been omitted.

In its place, Figure 2 specifies that there should be an analysis of the videotex system. The previous review of existing projects has underscored how factors such as limited frame storage, lack of grading capabilities, etc. can restrict the instructional design. Since options differ with different videotex systems, the designer cannot ignore the parameters imposed by the hardware configuration. Without thorough understanding of the capabilities

Figure 2: Videotex Development Process



of videotex systems, there is the risk of designing materials with conventions that cannot be achieved with certain systems. There is a clear interaction between technical capability and instructional and graphic design, and these ramifications must be kept firmly in mind throughout the development process.

Once a videotex system has been selected and there is a clear understanding of what it can and cannot do, planning of instructional strategies can begin. Since videotex is a computer-based system, it can present drill and practice, tutorial and simulation/gaming materials typically associated with computer-assisted instruction. As with any medium, however, the selection of appropriate strategies must take into account the nature of the learner and the content objectives. Other critical factors are the level of interaction required from the user, where feedback should be presented and what form it should take.

When the basic approach and strategies have been determined, flowcharts can be developed. A flowchart serves two basic purposes:

(1) It provides a structure for content development and scripting.

(2) It serves as a guide for preparation of the computer programming.

A general rule is that the more complicated the interactive/branching structure, the more critical the flowchart. For simple sequences the need for a flowchart becomes less important, and in some cases it may even be omitted in the interest of saving time. If one is not prepared, however, some branching or routing notation must be incorporated into the script so that someone unfamiliar with the content can follow the branching pattern.

Content and flowchart development have been listed together in Figure 2 because, in most cases, the two go hand in hand. A content package for interactive instruction is intrinsically different from that typically prepared for television and film. Content for a film can be linearly prepared with a beginning, middle and end (like a book) and then turned over to a scriptwriter or instructional designer to package for the medium. Content for an interactive program, on the other hand, must be developed for each possible branch and should show the relationship between branches. Although there is generally only one beginning, there may be numerous "middles" and "ends", and considerable effort is often spent in developing "wrong" answer branches. It is this structure which becomes the basic flowchart. The flowchart becomes the roadmap to guide more detailed content development, scripting and, eventually, the computer programming.

Script development follows flowcharting. The script contains information necessary for production of the individual frames. Scripts for interactive videotex programs bear little resemblance to those of television and film. Videotex scripts can be nonlinear and can contain hundreds of sequences whose relationship is only clear from examination of the flowchart. The script sequence is often not the same as the order in which the user will actually view the materials. Scripting requires great attention to detail and meticulous proofing. Scripts can run a thousand pages, and it becomes a true challenge to properly account for all elements and their relationship.

With script completion, the instructional design phase is

completed and production can begin. A major production element is frame development. Screens are prepared as independent units and can incorporate visuals, so graphic design is an important component. Frame development requires a skilled artist who is thoroughly familiar with the technical parameters of the system and comfortable with developing graphics using computers instead of pen and ink. Limitations imposed by the alphamosaic standard can be especially severe, and the designer must be sure that graphics will be compatible with the system.

In addition to frame development, the other production-related function involves computer programming. It is necessary that the branching networks, needed scorekeeping, etc., be entered in a form that the host computer can accept and execute. It should be emphasized that the programming function is not analogous to writing and entering a typical computer program. Computer programs generally include screen display commands in addition to branching and scorekeeping information, but in videotex development, screen design is an independent process.

Once the frames and computer programming have been entered, the instructional programs are complete and may be reviewed and debugged. Debugging "simply" involves checking all the branch points to be sure that they route students to the correct place. If any student responses are to be recorded and scored, the program should also be checked to see that such functions are executing correctly. Although this step is somewhat analogous to correcting errors in traditional mediated presentations, the debugging process is generally much more extensive and time-consuming. It is not uncommon for

debugging to take just as long as, or longer than, developing and entering the original computer program. Since computer programming requires the input of numerous numbers or codes, it is very easy to make a mistake, and it is difficult to spot mistakes once they are entered. Unfortunately, a one-number error can route a student onto a completely wrong branch, where it is impossible for him or her to find the way back to the correct point.

Since videotex production is a time-consuming process, it is important that problems be identified and appropriate revisions made as early as possible. Therefore, evaluation is a part of the development process because needed revisions require recycling through appropriate design-related steps. Evaluation activities can include reviews by students or experts of content packages, flowcharts, scripts, individual frames and fully assembled programs. One likely candidate for preproduction evaluation is the branching structure, since problems there have implications for content, computer programming and frame design. Early evaluations can isolate dead-end branches, closed loops, unclear transitions and confusing structure.

One simple way to test the branching structure is to use program scripts and simulate the branching by listing page numbers where students should be routed beside each choice at a decision point. This scrambled book approach follows the principle of branched programmed instruction. Students (or experts) can make their choice and proceed to the page indicated. With long scripts this method results in considerable paper shuffling, but it does test the branching structure, as well as providing information on program clarity and content accuracy.

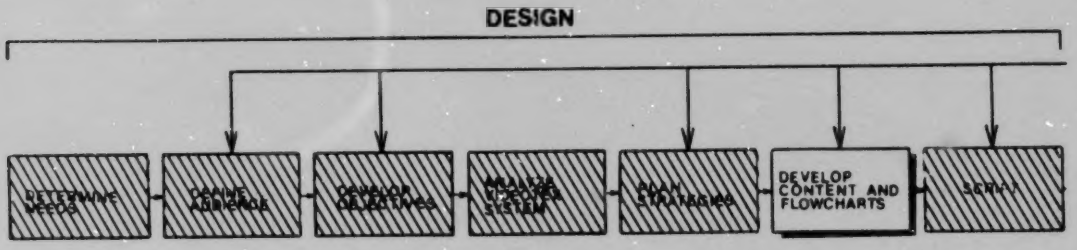
THE TEAM APPROACH

From this discussion of videotex development, it should be obvious that one person cannot embody all the talents needed to complete a videotex instructional sequence. Therefore, several people must work as a unit. The team approach has long been advocated for the development of instruction utilizing new technologies. As early as Sesame Street days, experts recognized the value of a team approach: "As technologically sophisticated forms of instruction come into increasing prominence, it will be necessary to make increased use of production teams whose members possess a diversity of highly specialized talents" (Palmer, 1974, p. 325).

Videotex teams may differ in complexion depending on the nature of the project and the expertise of team members, but the functions outlined in the previous section must be accomplished. Teams may include content consultants, instructional designers, scriptwriters, graphic designers, computer programmers and evaluators. Sometimes one person may wear two "hats", and because there are no clear-cut lines between the various functions, it often becomes difficult to determine where one person's responsibility begins and another's ends.

CHAPTER THREE

FLOWCHARTING

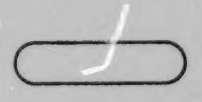


Once the objectives and general approach for videotex sequences have been determined, specific development begins. A critical element of this process is the flowchart, which becomes the roadmap for preparation of the content, script and computer programming. It serves as a central focus, not only to guide program development, but also to facilitate team interaction.

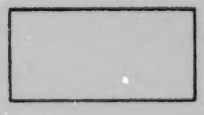
Exactly where in the design process a flowchart is prepared, for what purpose, and by whom depends on the complexity of the instructional sequence (in terms of branching requirements) and the expertise of team members. For simpler instructional sequences, the need for a flowchart becomes less important, and in some instances it may even be omitted. For example, testing sequences and branching structures where incorrect responses are immediately fed back into the main branch may not require a flowchart. In such cases, a content consultant may be able to prepare the basic script without the use of a flowchart by using some simple branching notation at decision points. One method is to simply list the page number where the student should be routed beside each choice. For testing sequences, the question and correct and incorrect feedback can be typed on one page. How the

branching is noted is really unimportant. What is important is that branch points be delineated so that someone unfamiliar with the content can correctly follow them. This procedure will insure that the script is correctly assembled and the computer programming correctly entered.

On the other hand, for preparation of complicated branching structures, especially those associated with gaming and simulation exercises, a flowchart becomes critical. A superior product can result when the flowchart is jointly developed with all team members having input. In this team setting, the instructional designer can provide input on appropriate instructional strategies, the content consultant can provide needed content expertise, the programmer can provide input about programming parameters, and the graphic designer can provide visualization suggestions. In preparing the flowchart, typical computer symbols can be used.



---------- To start or end a program



---------- An instruction or operation

---------- Decision Point

---------- Connector to show where flowchart is continued

---------- To show direction of flow

Although standard symbols have been developed for flowcharting, each project may have its own symbol requirements. For example, decision points are commonly used for "yes, no" options but are unwieldy when used with education's typical 4- or 5-choice multiple-choice format. Also, if a flowchart is being prepared as a guide to script development, it is important that enough content be presented so the purpose of each step is clear. Since a great deal of text usually needs to be presented, it is obvious that a diamond is a very inefficient symbol. In order to maximize text presentation, a rectangle may be a better choice to represent each screen -- whether it is an explanation frame or a decision point.

The first draft of the flowchart resulting from team meetings is likely to be a mess of erasures, crossouts and spaghetti-like paths. Team meetings are give-and-take sessions, characterized by false starts and both good and bad ideas. The first draft of the flowchart is generally redone in better form so that all team members can follow the logic.

In order to facilitate communication between team members, each symbol on the flowchart should be numbered. This number will provide easy identification and reference, and the number can also be used to identify script segments and completed frames. Because there are likely to be additions or because frames may become too long and have to be split, it is recommended that numbering proceed by tens. This procedure is standard in computer programming and allows the addition of frames/steps without renumbering.

In general, the more elements involved in a program, the more complicated the flowchart. It is important that the structure be

clear and communicate the intent to all team members, regardless of the form or the symbols used.

The flowchart should be scrutinized to be sure that no branches suddenly dead-end, that there are no closed branching loops from which the learner cannot escape, and that the branching structure allows the learner to proceed at his/her discretion with little confusion. It can serve as an excellent review tool, because it is the structural map of the program.

Figures 3 and 4 are presented to provide some examples of flowcharting. A section of an actual flowchart developed for the Nebraska Project is included in Appendix A.

Figure 3: Simple Interactive Strategy Showing Forward and Backward Branching

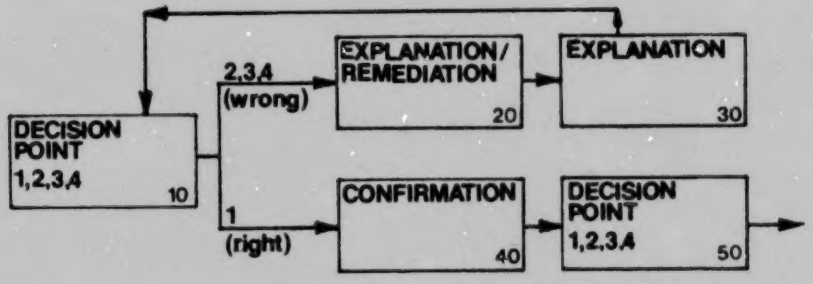
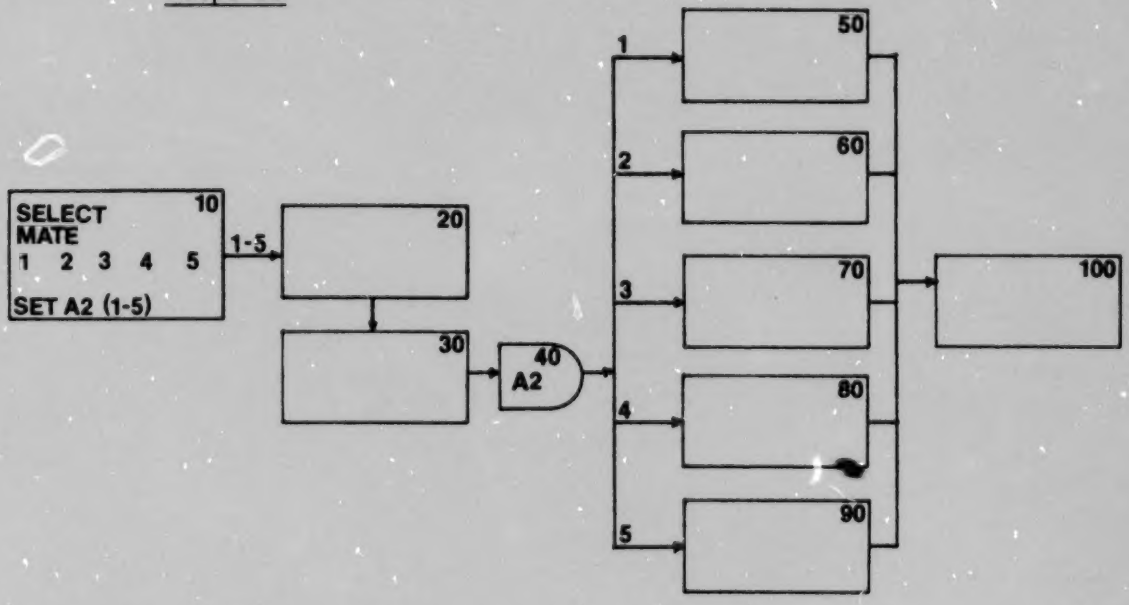


Figure 3 is a simple flowchart showing both forward and backward branching. Backward branching occurs when students make incorrect choices or want to try a different strategy. In such cases, they are backtracked to an earlier decision point and given the opportunity to select a different option.

More sophisticated computer programming requirements, such as computations (needed for grading) or recordkeeping, should be recorded on the flowchart to aid preparation of computer programming. If such operations have no bearing on script development, they can be omitted for that purpose. They should, however, be added before preparation of the computer programming. Different symbols can be used to graphically depict different computer operations. For example, branching based on the value of a single response or cumulative total of responses is shown in Figure 4.

Figure 4: Flowchart Showing Branching Based on Value of a Stored Response



In the example above, the student makes a selection (1-5) at step 10 in the flowchart, and this response is recorded by the computer in storage point A2. At steps 20 and 30, the student is provided with additional information. At step 40, the student is branched to 50,

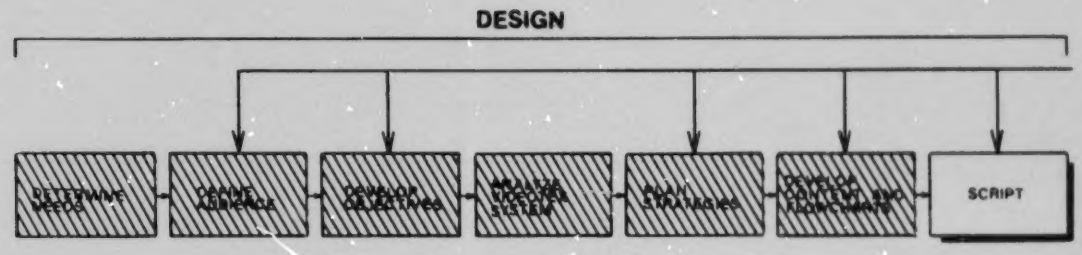
60, 70, 80 or 90, depending on the value recorded in A2. All branch paths then converge at step 100.

At step 40 no frame is displayed; it is a computer function only. Therefore, a different symbol has been used to distinguish it from steps where a frame is shown (rectangles). If there are steps where only computations are being performed, another symbol can be used. The importance of the symbols is that they provide a quick identification of what is happening at a particular step. In the example above, a reviewer could easily discriminate steps where frames are displayed and steps that involve only computer operations.

It should be reemphasized that the flowchart is used in different manners by the programmer and the scriptwriter. The writer is concerned with content and program flow in terms of the various paths and options open to the student. The programmer, on the other hand, could not care less about content. He or she is interested in program logic, the structure connecting the flowchart symbols, needed computations, etc. Since the flowchart must serve two purposes, it can become so overloaded with text and notations that the content explanations and computer statements compete for prominence and require "fishing out" by the respective user. One solution to the problem is preparing an original copy with only the symbols and directional flow and making two copies--one to contain the content information for the scriptwriter and the other with computer information for the programmer.

CHAPTER FOUR

SCRIPTING



GENERAL CONSIDERATIONS

Scripts for videotex programs must account for the visual and text display, just as televison and film scripts delineate video and audio. As videotex instruction becomes more interactive, however, the resemblance to film/television and even slide/tape scripts decreases dramatically. A videotex instructional segment can consist of hundreds of frames whose relationship is only clear from examination of the flowchart. In working with such instruction it is critical to think nonlinearly. The writer may prepare one sequence, and depending on the complexity of the branching structure, prepare a follow-up sequence weeks later. The various tracks or story lines must be kept firmly in mind because the instruction is not likely to be written sequentially.

Another consideration is that videotex is not a replacement for a book. Studies have shown that users do not like dense frames (Carey, 1981), and it is usually recommended that frames contain only 50-70 words. Part of the difficulty is the limited number of words that

can be presented on a screen. Most systems use a 32 x 16 or 40 x 20 format (number of columns x number of rows), which greatly reduces the amount of print that can be displayed at one time. Continuous pages with large amounts of text, especially if they do not solicit a response from the student, would be better handled in print form. Unfortunately, educational materials, and particularly those for higher-level audiences, tend to be very verbal and require considerable text presentation. To limit the amount of text display, information should be concise and tightly edited. This conciseness can become a strength. Students in videotex evaluations have noted that videotex material presents only pertinent information, while print information may present a great deal of extraneous information (Montgomerie, 1982, p. 56; Goldman, et al., 1982, p. 35).

Another consideration is the reading level of the material and its appropriateness for the audience. Special care should be taken in developing programs for younger children and special audiences, such as the hearing impaired. For materials oriented toward younger audiences, for example, the developer might consider spot checking the materials using some of the better known readability formulas such as the Maginnis Readability Graph (Maginnis, 1969) and Dale Chall Readability Formula (Dale & Chall, 1948).

To improve readability, sentences should be short. Semicolons should be avoided. It is better to use two sentences. Care should also be taken to avoid breaking paragraphs and particularly sentences onto subsequent frames. In cases where there is no alternative but to split a paragraph, the reader could be alerted to the continuation with a heading, e.g., "second paragraph continued."

SCRIPT FORMAT

As discussed in the previous section, the flowchart becomes a guide to script development. The script expands upon the cryptic content notations in each flowchart symbol and contains information necessary for production of the individual frames. Cross referencing between the script and flowchart is accomplished by identifying each scripted frame (page number) with its corresponding reference number on the flowchart.

The three-column script form found in Figure 5 is the videotex script format used by the Nebraska project. This form was modified from one developed by Cox Cable for INDAX. A separate script page is devoted to each frame. The first column (far left) is used for descriptions of graphics. Any suggestions for visuals from the content consultant or instructional designer are noted here. When the graphic designer reviews the script, his or her ideas are also indicated in this column so that the final script reflects visual components of the completed frame. The middle column is for text presentation and reflects the INDAX 32 x 16 screen specifications. It allows for 16 lines of 32 characters each.

Line 1 is reserved for a frame and lesson identifier and/or identification number. A frame identification is often used to specify the topic of the lesson, such as "Memos" or "Adam Smith." An identification number is assigned by the development staff according to system specifications and project needs. To provide another cross-reference, the number can incorporate the one assigned at the flowchart stage. It can be used to aid in debugging (to be sure branches connect the correct frames) and to provide a means of identification and location for a student.

Figure 5: Sample Scipt Form

POLITICAL SCIENCE

SUBJECT: FASCISM SELF-CHECK #4

PAGE 64OF___

FRAME #NPS01350640

NODE # 350640

Designer's Production Instructions and Specifications		Text: 32 characters by 16 lines double-spaced	elite	pica	Copy-editing, Proofing
	1	FASCISM SELF-CHECK 350640		1	
	2			2	
	3			3	
RIGHT DONE AS DISPLAY	4	RIGHT		4	
TEXT IN LARGE LETTERS	5			5	
	6	EMPHASIS ON ACTION AS OPPOSED TO		6	
	7	THOUGHT OR CONSISTENCY IS		7	
	8	CHARACTERISTIC OF FASCISM.		8	
	9			9	
	10			10	
	11			11	
	12			12	
	13			13	
	14			14	
	15			15	
	16	PRESS NEXT FOR NEXT QUESTION		16	

BRANCHING INFORMATION:

SPECIAL INSTRUCTIONS:

Although it is usually recommended that some identification be used, keep in mind that lessons which are text-intensive often require a full 14 or 15 lines of print. In such cases the frame becomes even more dense with a print identifier on Line 1. To improve aesthetics and readability this identification can be omitted. To insure consistency, however, lessons should follow a similar format.

Line 16 (and sometimes line 15) is reserved for routing instructions to the learner. The following routing instructions have been used in the Nebraska Project:

1. PRESS NEXT - Used when the student is to advance to a subsequent page or frame
2. PRESS NUMBER - Used at a menu or decision frame when a student is presented with several numbered options and must input a choice
3. PRESS BACK TO REVIEW - Generally used in conjunction with another command (such as "OR PRESS NUMBER") when information relevant to a particular decision point must be presented on separate frames
4. PRESS MENU - Used when a student is to return to a major menu (such as a glossary menu) to make another selection

Because the computer will accept any numerical input, routing instructions are sometimes frame specific. For example, a frame requesting that a student enter his or her age displays the routing instruction "ENTER NUMBER OF YEARS."

The third column is used for copy-editing and proofing notes and questions. When working in a team setting, several people usually

must sign off on the script, and this column provides a space for corrections.

At the bottom of the form is a space for branching information. This area is used for any computer programming notes, such as a notation that a student response is to be recorded at this step. This space is also utilized to note branching information when no flowchart has been developed. In such cases, a simple notation can be used. "1-42, 2-43, 3-44, 4-60" would mean that if a student has selected choice 1, he or she should be branched to page 42, etc.

The "special instructions" area on the form is used for whatever needed. Often it is used by the instructional designer to note or explain some unusual feature of the frame to the person who will be inputting, e.g., "Representative is deliberately misspelled in this frame. Type it exactly as it appears in the script."

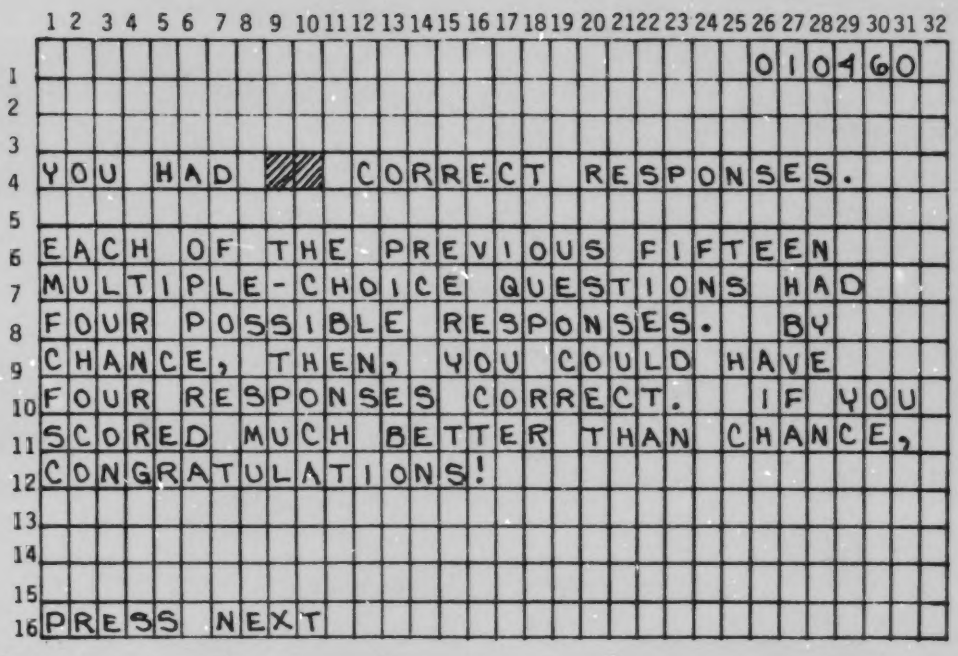
The script form used in Figure 5 is a general purpose form. In special cases, however, a more detailed form may be needed. Such a form is shown in Figure 6. This form represents a 16 x 32 grid. When text placement is critical and must be exact, this form is hand lettered showing precisely how the text should appear on the screen. One common use is when a blank must be left on the frame for display of a computer-generated grade or total. The computer program specifies the row and column where a grade should be displayed, and corresponding space must be left on the frame itself.

Figure 6: Script Format with Grid

PAGE 46OF___

FRAME #NSC01010460

NODE # 010460


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
0 1 0 4 6 0
YOU HAD /// CORRECT RESPONSES.
EACH OF THE PREVIOUS FIFTEEN
MULTIPLE-CHOICE QUESTIONS HAD
FOUR POSSIBLE RESPONSES. BY
CHANCE, THEN, YOU COULD HAVE
FOUR RESPONSES CORRECT. IF YOU
SCORED MUCH BETTER THAN CHANCE,
CONGRATULATIONS!
PRESS NEXT

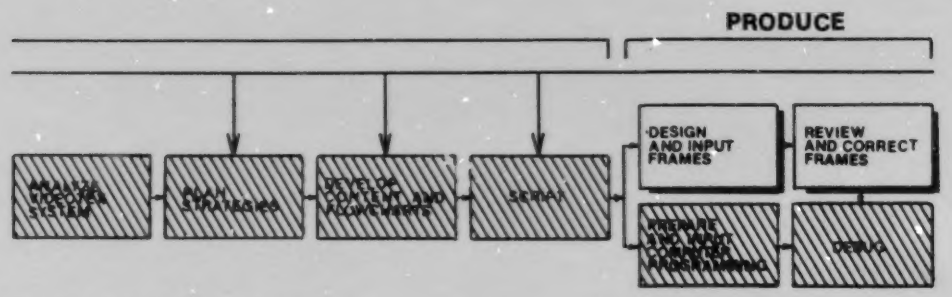
BRANCHING INFORMATION:

A3 DISPLAY AT 4,9-10

SPECIAL INSTRUCTIONS:

CHAPTER FIVE

GRAPHIC DESIGN/FRAME DEVELOPMENT



GENERAL CONSIDERATIONS

Once a final script and, if needed, flowchart have been prepared, frame develoment and computer programming can proceed simultaneously. (Computer programming is the topic for chapter six.) Although the final product cannot be viewed until both are completed, frame input is not dependent on completion of the computer programmming or vice versa.

With the script in hand, the graphic designer can review the content of each course or segment to make decisions concerning the graphic elements (color, spacing and layout, and graphic illustrations). The goal is to achieve maximum visual and instructional impact, as well as to provide stylistic continuity.

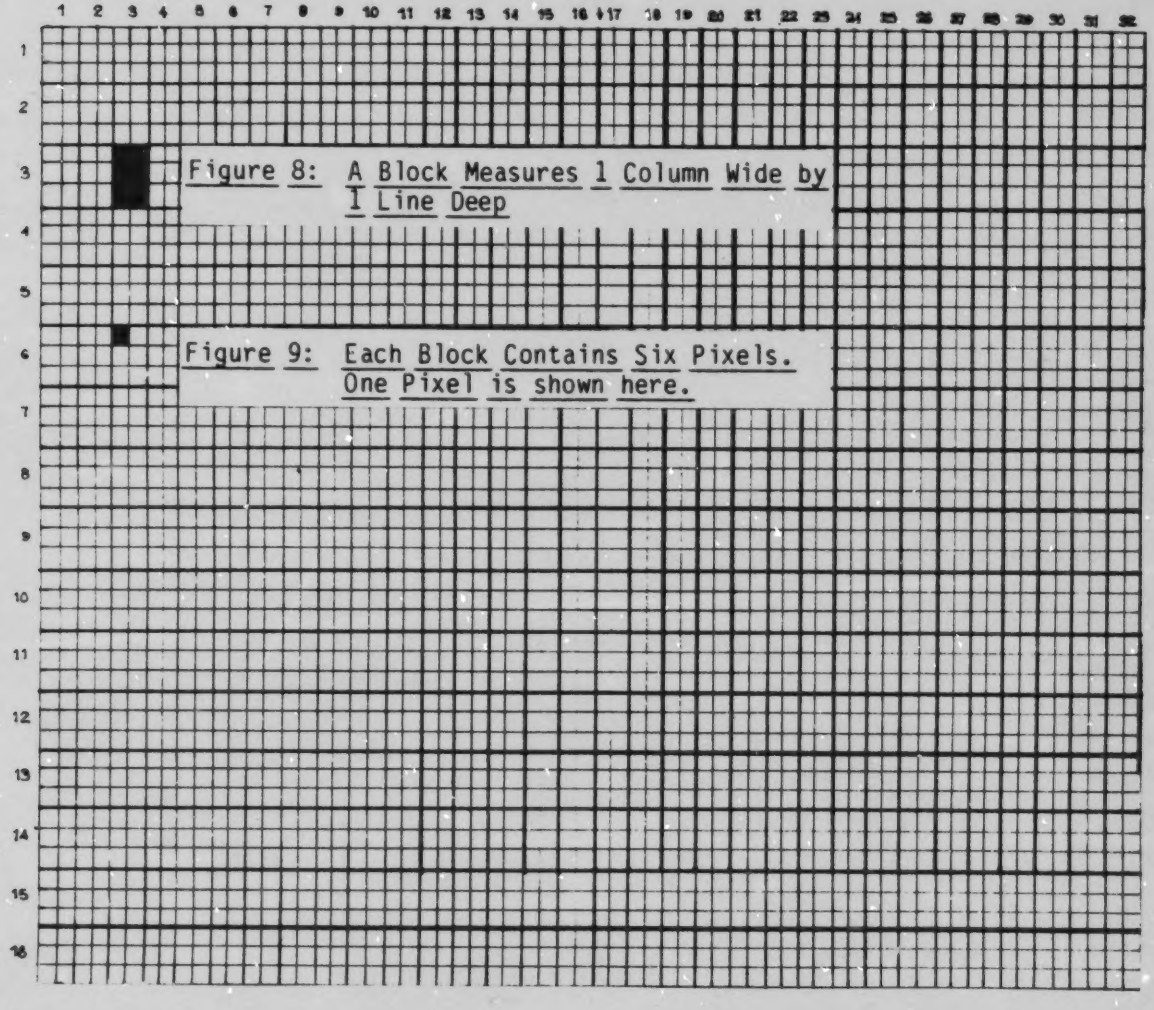
Initial decisions concern the overall layout of frames with the intent of providing stylistic consistency across frames in particular segments or subject areas. Clear and consistent patterns of graphic and text presentation will facilitate viewer recognition and add a sense of coherence to individual segments.

Choices are made as to background and text color for maximum legibility and the selection of complementary colors for lines containing routing and identification information. Color coding, spatial coding

or emphasis and tentative ideas for graphic illustrations are noted in the left hand margin of the script page under "Designer's Production Instructions and Specifications" for possible later development.

As with most art forms, ideas for a videotex frame are developed on paper. A specially prepared matrix board is used which reflects the matrix of an INDAX frame and becomes a simple blueprint of how the final frame will appear (Figure 7).

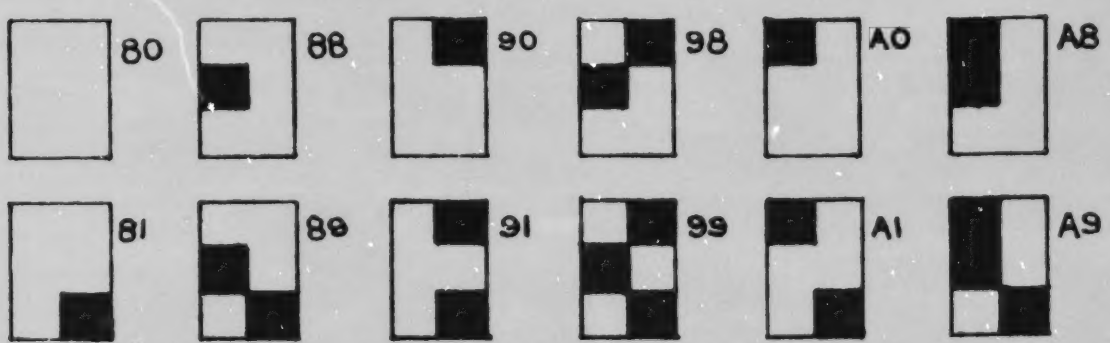
Figure 7: Matrix Board: (Reduced in size)



Each frame is divided into sixteen lines deep by thirty-two columns wide. Blocks are the largest design units within the matrix grid. Each block measures one column wide by one line deep for a total of 512 blocks or image units (Figure 8). The block is further subdivided into smaller units called pixels (short for picture element). There are six pixels of equal size in every block arranged two across, and three down (Figure 9). Pixels, the smallest design unit, are filled within each block to create graphic illustrations, decorative motifs, or display text. (Display text refers to any text which is larger than the one character per block alphanumeric text available with INDAX.)

The unique patterns created by filling in pixels are referred to as semigraphics. There are 64 possible pattern combinations in semigraphics and each has a specific computer code relating to a semigraphic block arrangement (Figure 10). The graphic capabilities of INDAX are premised on an "alphamosaic" standard because the system must use semigraphic character codes for recording graphic shapes. In other words, illustrations on INDAX are alphamosaic arrangements or tile-shaped elements that represent objects, ideas or motifs for non-print enhancement.

Figure 10: Twelve of the 64 Possible Pattern Combinations in Semigraphic Code



Before developing any visual concept on the matrix board, the graphic designer must take the following into account:

-- The given area--32 columns across by 16 lines down--must incorporate a frame identification number and/or subject identifier on line 1 and instructions to the user on line 16. Since these two lines have dedicated functions, available frame space is even further limited.

-- Due to the low resolution characteristics of alphamosaics, a graphic illustration will not have the fine details of a photograph. Although videotex technology is improving, alphamosaic graphic illustrations can only serve as a representation of an object. The pixel is a coarse medium. Elements that are not horizontal or vertical may appear jagged. Therefore, complex and/or detailed illustrations are difficult to create without using a majority of the frame space, and graphics can easily become unsophisticated and amateurish in quality.

-- Only two colors may be used per INDAX block including the background color. The second color must be introduced to the block on a pixel by pixel basis. (This will be covered more fully later in this chapter.)

-- The maximum byte count of each frame is 512 which further limits the use of very elaborate designs or color changes.

-- INDAX to date utilizes only uppercase alphanumeric text characters which have legibility and spatial problems in themselves. Each block can contain only one alphanumeric character or be left blank for word spacing. Even punctuation requires its own block and cannot be combined with an alphanumeric character in the same block.

Graphic design must achieve a critical balance between optimal frame fill and the use of graphic illustrations. Graphic illustrations can enhance the appearance of a text frame and provide visual relief and interest. They can provide a conceptual base or visual sense of what to expect from the text and aid comprehension. It should be noted, however, that the emphasis is on maximizing the interaction between the pictorial and linguistic modes, using each to its best advantage to present concepts or facts. Remember, the graphic emphasis should be as an adjunct to the text, not a replacement.

COLOR

The most commonly used design element on an INDAX frame is color. The use of color reduces boredom and increases a viewer's interest. All illustrations (including display text) and alphanumeric text can be displayed in any of sixteen colors available with INDAX.

The only limitation to color availability and use depends on the legibility/compatibility factors of the colors desired. It should be obvious that the selection of dark green would not be compatible with a red counterpart. Frames composed using highly contrasting color patterns usually result in image blurring and visual tension. To a certain degree, the designer can control these problems by placing neutral colors (black, white) between contrasting colors.

The colors selected when building an INDAX frame are not always what they seem. The intensity and brightness of most colors will appear different on the completed frame. As an example, the selection of light red will appear pink, and dark yellow inclines toward brown. Before coming to any final conclusions about color, however, the designer should be aware that the display and image resolution of each frame will vary from TV set to TV set. Although the designer has no control over the viewing conditions and set adjustments which could change the color greatly, he or she should be able to get an accurate visual sense of the color choice selections as they appear in black and white by viewing on a black and white TV set.

One way of insuring continuity is to use the same background color, border design and text layout to identify frames dealing with the same concept or topic (Figure 11). The most effective unified color pattern used to compose an INDAX frame is achieved

Figure 11: Example of the Same Background and Text Color to Insure Continuity

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by using a dominant color in conjunction with an analogous color. As an example, one could choose a cyan light as a background color and cyan dark for text (analogous), with emphasis placed on frame identification and routing in white.

Color is also used to enhance the communication and display of information by highlighting key elements on a frame. Known as color coding, this procedure is also used as contrast between similar data, division of data and hierarchy of data such as headings and subheadings and questions and choices. Effective color coding allows the designer to organize and streamline the information contained in each frame and is especially effective in "text heavy" frames. (Figure 12).

Figure 12: Example of Color Coding Used to Highlight Key Elements on a Frame

It is best to limit the number of colors used on each frame. The designer should not deviate from the initial color choices for background, text, frame identification and routing. Adherence to

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these three colors will insure continuity of related frames, segments and subject matter. The introduction of any more than one additional text color will result in a "busy" look and distract from the message. Caution should be used in introducing too many colors in any graphic illustration. In some cases, the designer will have little choice, since only two colors can be used per block and one of those is the background color. The total byte count will also limit the number of color changes. In any color selection, it is best to let sound graphic design sense be your guide.

ALPHANUMERIC TEXT CHARACTERS

Blocks are the smallest text design units. On INDAX, the upper-case letters A through Z, numerals 0 through 9, and 27 special characters, such as punctuation marks, are the alphanumeric characters available.

When designing text for maximum readability, the following guidelines should be considered:

-- Spatial coding, such as a line separating paragraphs, is effective in alleviating text density and promoting clarity of message. If spatial coding is not possible due to the amount of text, color coding is advisable to differentiate various points within the text.

-- Abbreviations generally should be avoided to prevent possible confusion arising from poor character legibility on the variety of user's TV sets.

-- Centering text is an example of clever layout which can break up print and call attention to important facts or titles.

-- Dividing a word between two lines should be avoided, if possible.

-- Improved legibility on menu or decision frames will result if the numerical choice appears to the left of the item and a blank line can be left between choices. It is also acceptable for short items to appear in two columns.

Specifying the color for alphanumeric text in either normal or reverse video will change the background color of the block in which you insert a character. In normal video, the color selected becomes the alphanumeric text color while the block background becomes nearly black with a hue of the color specified. In reverse video, the color specified becomes the block color while the alphanumeric text is nearly black with a hue of the color specified (See Figure 13.)

Light colors for both normal and reverse video text provide the maximum contrast for legibility, and dark background colors are generally best for the display of larger volumes of text to minimize viewer fatigue. When using white reverse video with another color (i.e., background or graphic illustration), the text will reflect the color(s) and could become difficult to read.

Figure 13: Examples of Normal and Reverse Video Text Available with INDAX

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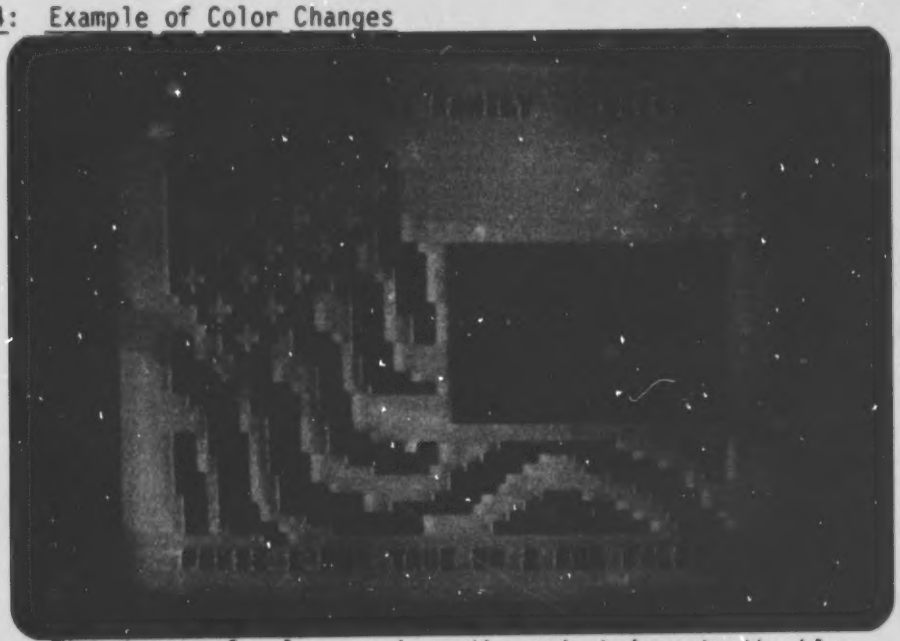
DESIGNING THE FRAME

The most effective way of designing for an INDAX frame is to layout an initial rough in outline form on the matrix board and then adapt it within the constraints of the system. The graphic designer soon learns that quite often realistic graphic representations, which so appropriately visualize the text message, are not nearly as effective when translated into alphamosaics.

Perhaps the biggest constraint is the limitation of only two colors per block. After the choice is made for a background color, the introduction of two or more additional colors can only take place on a one color per block basis. As an example, the flag shown in Figure 14 is built on a white background. Where it is necessary to have the red stripes touch the blue field, they can only do so from one block to another. Any deviation from this procedure will result in a computer override and the entire block will be read as the most predomi-

Figure 14: Example of Color Changes



The change of color, such as the red stripes to the blue field, can only occur from block to block.

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nate color within that block. In other words, if three of the six pixels within a block were designated as red and one pixel as blue, the computer would read it as red.

Usually when these limitations are realized, the graphic designer will no longer view them as such -- but rather as challenges inherent to the system requiring an in-depth search for his or her most creative efforts.

Almost every frame has some alphanumeric text. When the designer combines text with an illustration, it is best to indicate where the text will be placed on the matrix board. This placement will serve as a quick overview of how much space can be used for the illustration. It is ideal to have 50% of the frame available for graphic illustration; however, very effective and creative representations can be developed in less space (Figure 15).

Figure 15: Examples of Text and Graphic Combinations

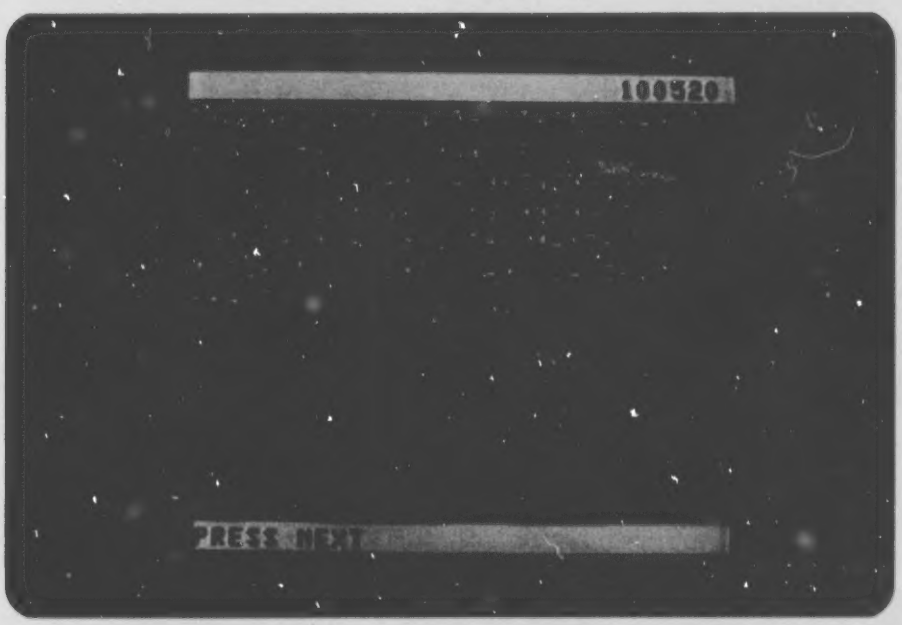

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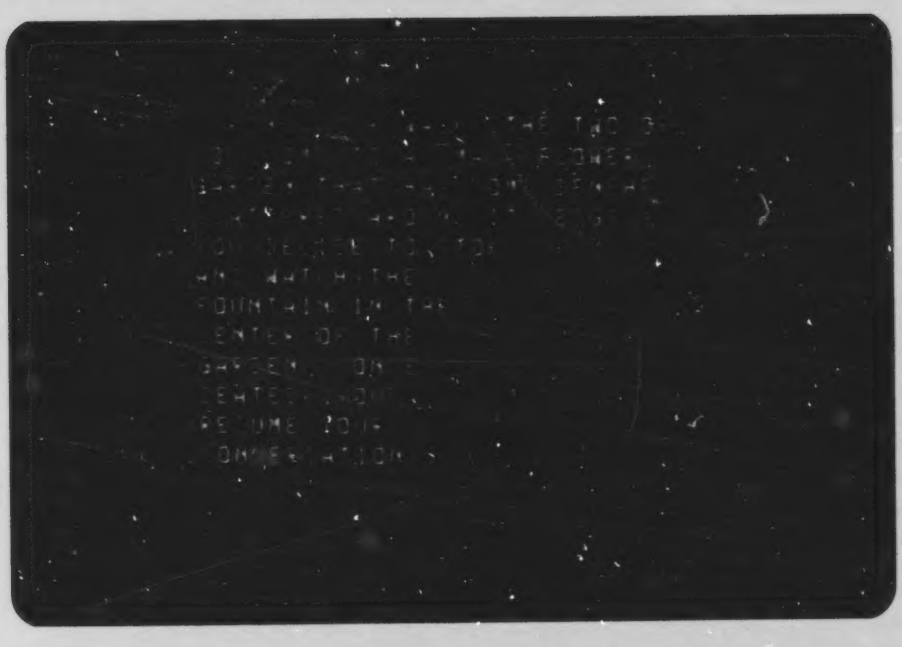
Figure 15 (continued)



INPUTTING THE FRAME

Once the layout of a frame is completed on the matrix board, the actual building process begins. Frames are created off-line using a Norpak Information Provider System (IPS), which is based on Telidon, the Canadian videotex/teletext system. A drawing of the Norpak system is found in Figure 16. This computer system allows the designer, using a keyboard, to draw and type in color on a picture screen and to modify the text or drawings at will until the desired result is obtained.

The IPS includes a central processing unit and dual drive 8" floppy disks. This terminal also has a menu screen which is used to display information required during the operation of the IPS. The keyboard is used to give commands to the IPS and would appear familiar to anyone who has used a typewriter. There are 18 additional function

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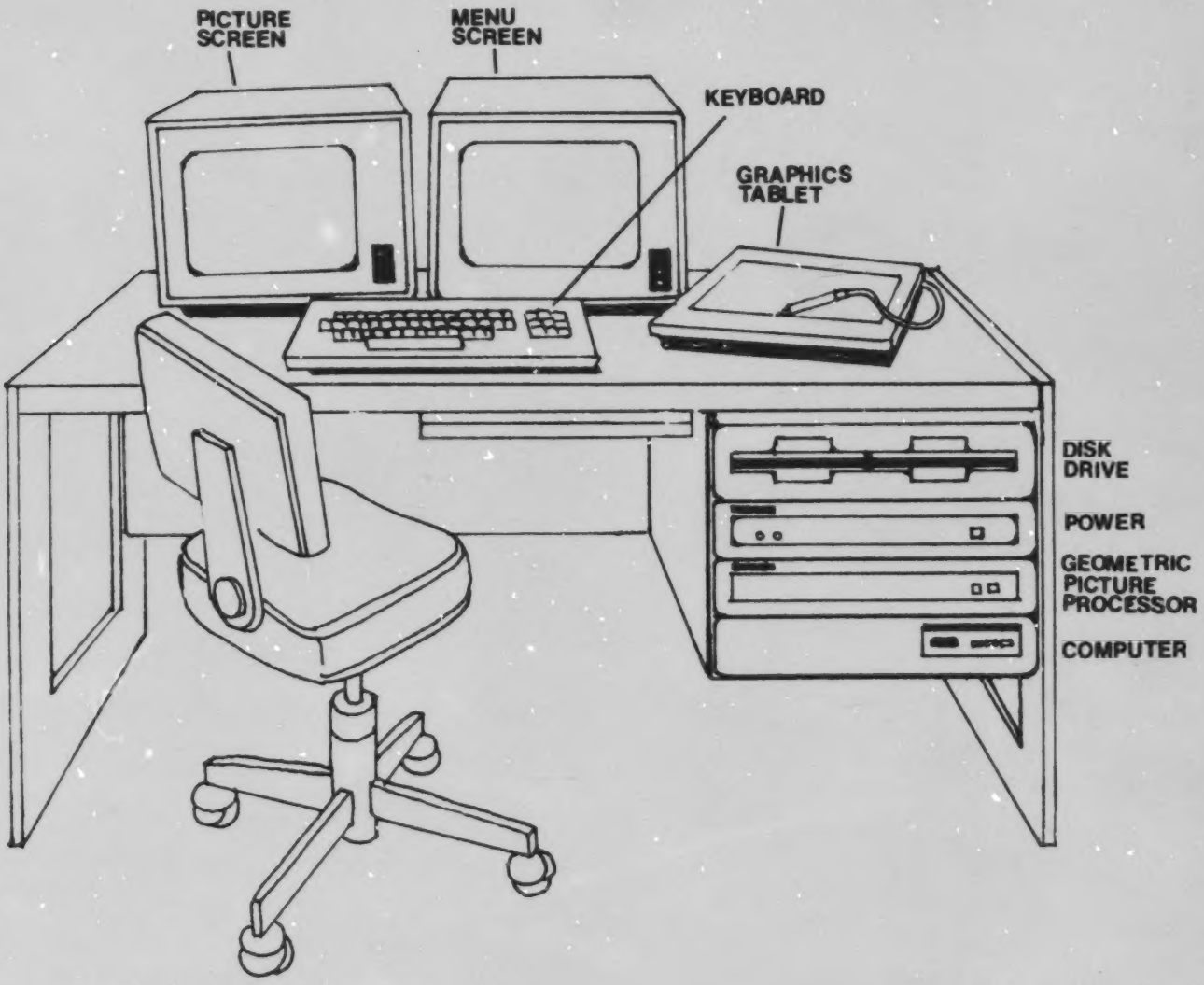
Figure 16: Norpak Information Provider System



keys along the top called "pushbuttons" which are used for picture editing. On the right hand side of the keyboard is a cluster of keys that control the movement of a cursor on a pixel-by-pixel basis in any of eight directions. Moving the cursor to a desired location within a pixel and entering a command enables the building of frames. Care must be taken that this command is entered when the cursor is in the very center of a pixel.

The "user grid" supplied with the IPS displays an exact duplication of the matrix block and pixel location. Used as a drawing aid, this grid permits quick location of any pixel. A digitizing graphics tablet is also available and requires some practice to become proficient at creating INDAX frames in this manner.

As mentioned earlier, all illustrations on INDAX are developed by filling the desired area pixel by pixel. With 3,072 pixels in each frame, creating an image pixel by pixel would be difficult and time-consuming. Therefore, specific instructions, which simplify the drawing process, can be given to the IPS.

The following elements, which are supplied in the geometric picture processor, are the basic building blocks used to construct graphic illustrations specifically for INDAX. Note that many of these elements are identical to ones used to construct graphics in alphageometric form; however, INDAX does not permit arc or circle displays:

DOT - Draw a dot in a specific pixel location;

LINE - Join any two dots with a straight line;

RECTANGLE - Draw a rectangle by selecting two diagonally opposite corners; and

POLYGON - Connect any number of dots with lines.

In addition, the following "edit" commands allow for quick changes. As shown in Figure 17 any graphic illustration or its subcomponent (dot, line, rectangle, polygon) can be:

MODIFIED - To change or fill with color;

MOVED - From one location to another;

REFLECTED - As in a mirror;

COPIED - In another location on the frame;

SCALED - Up or down;

ROTATED; and, if desired,

ERASED!

Figure 17: Graphic Examples of Edit Commands

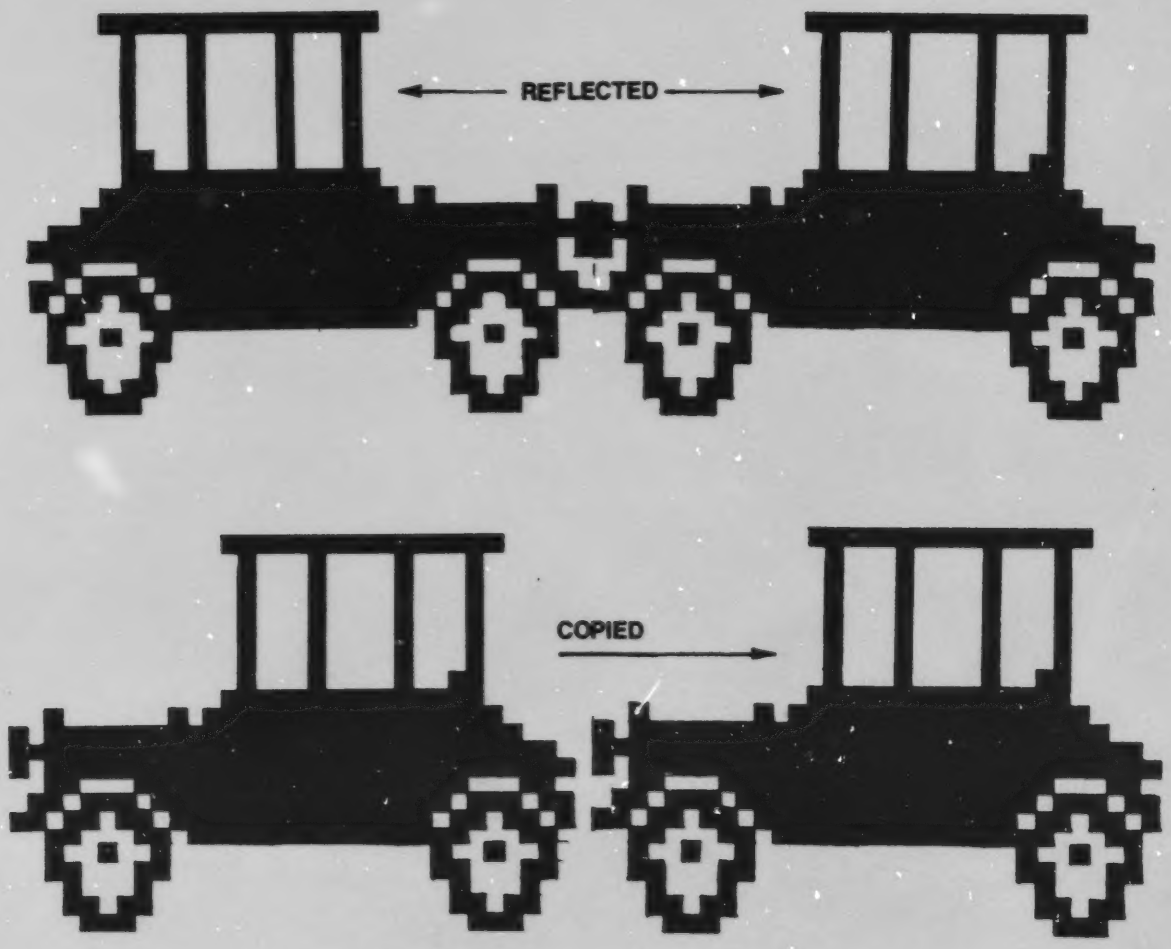
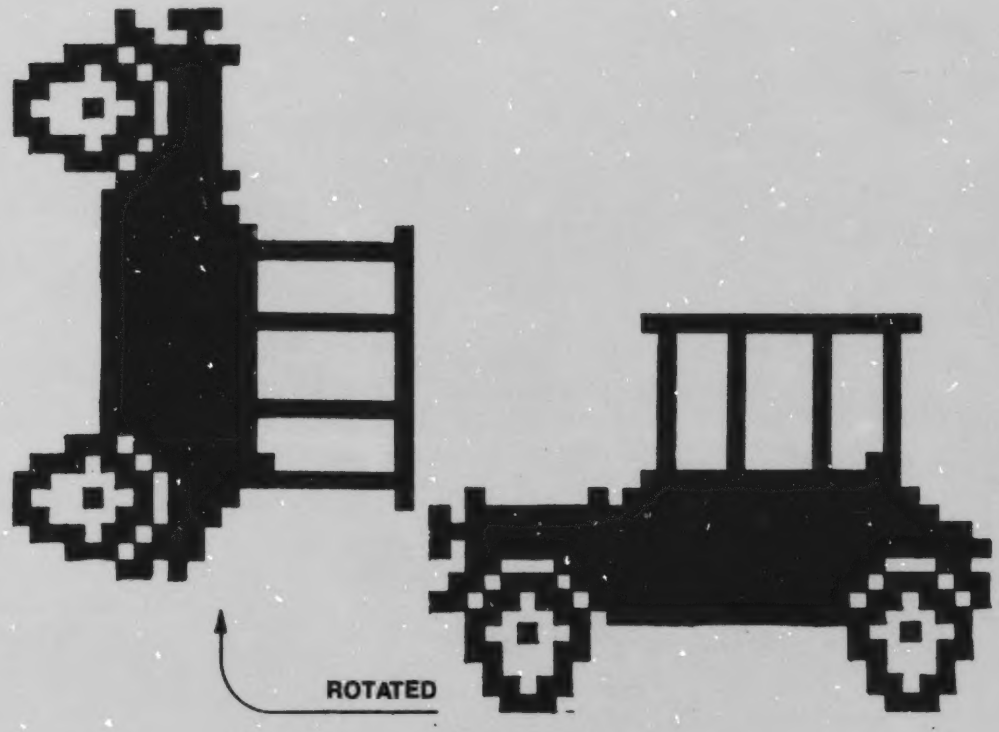


Figure 17 (Continued)



Any frames requiring display text larger than one block or three pixels high must also be built on a pixel-by-pixel basis. Using the basic command for lines and dots, the most versatile and smallest of display text is five pixels high by three pixels wide (See Fig. 18). Larger alphabets are derivations of this approach.

Figure 18: Example of the Smallest Display Text Which is Five Pixels High by Three Pixels Wide

Display text should be consistent within related frames dealing with the same subject matter. This consistency refers to type character, upper and lower case type development and general characteristics. Serif, sans serif, decorative and script typefaces can be successfully developed within the parameters of alphamosaic (Figure 19).

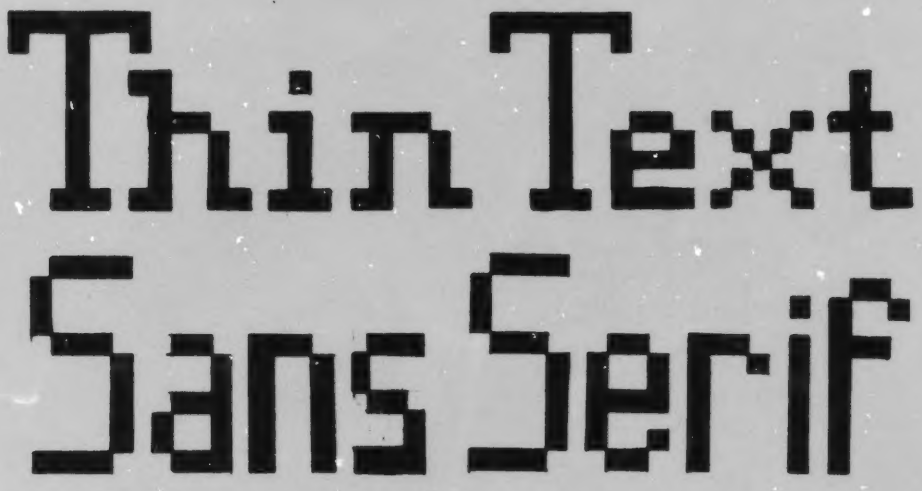
ADDITIONAL IPS FUNCTIONS

Storage

The IPS stores a description of the completed frame on a floppy disk for later recall. The IPS uses two 8" disks: a systems disk and an operator disk. The systems disk contains the information needed for the operation of the IPS, and the operator disk stores the completed frames. One important characteristic of computer graphics, as built in Telidon format, is that the pictures are redrawn every time they are recalled. The designer will see the picture recreated before his or her eyes "brushstroke" by "brushstroke." This is not the manner in which completed frames will appear to the user. On the INDAX system the entire frame is displayed once it is accessed.

Figure 19: Four Examples of Display Text Which Are Compatible with an Alphamosaic Format

Figure 19 (Continued)



Templates

The storage and recall function of the IPS provides the designer with an invaluable time-saving device. Once the choice has been made as to text color of frame identification and routing and background color, a basic frame containing these elements can be built. This frame, called a template, will include the appropriate subject identifier and frame identification number on line 1 and the most commonly used routing instructions on line 16. Except for background color, the rest of the frame is without text or graphic illustration. Stored under an easily-remembered name, this template is quickly recalled for the insertion of the appropriate text and/or graphic illustrations. By using the template, the designer does not have to respecify color or retype repeated identification and routing instructions for each frame. Subsequent frames are stored under names different from the template. Thus, the blank template can be recalled as needed.

Text Editing

Another invaluable feature of the IPS is text editing. This capability allows for erasure or insertion of alphanumeric text at any location on the frame one block at a time. For example, the frame identification number on line 1 of the template can easily be edited to reflect the change of frame. The "enter" command is given at the point of the needed correction; the block or blocks which contain the incorrect alphanumeric text are erased, and the new text inserted in its place. The edit mode is used in the same manner to correct typos or to make any content corrections.

New Frames From Old

Frames which are identical except for the frame number and one or two words can quickly be created. The designer simply recalls the completed frame, makes the needed changes and stores this newly created frame under a new name. Storing a frame under a different name does not erase the original frame. A separate command is used to erase existing frames, and to prevent oversights the IPS will require confirmation of this command.

It should be noted that frames containing the same graphic illustration can also be developed for repeated use. In this case, the graphic is created on the existing template and stored under a different name. It can then be recalled, the identification number changed, and the appropriate text inserted. Finally, it is stored under the specific name for that particular frame.

TRANSLATION

Once the frame is built to the designer's specifications, the translation process begins. This process translates the Telidon-built

frame into a form that the INDAX system can digest. A special computer program developed by Cox Cable requires only the entry of the nine-digit Norpak file name to equal the translated INDAX frame.

Once again, because of the unique characteristics of Telidon, the pictures are redrawn "brushstroke" by "brushstroke." The computer fills in the entire pixel as instructed by the designer when he/she entered the command for a specific element (i.e., dot, line, etc.). This redrawing and filling process is not instantaneous. Text-predominant frames can be displayed in a few seconds, while the more complex graphics may take up to three minutes.

TRANSFER

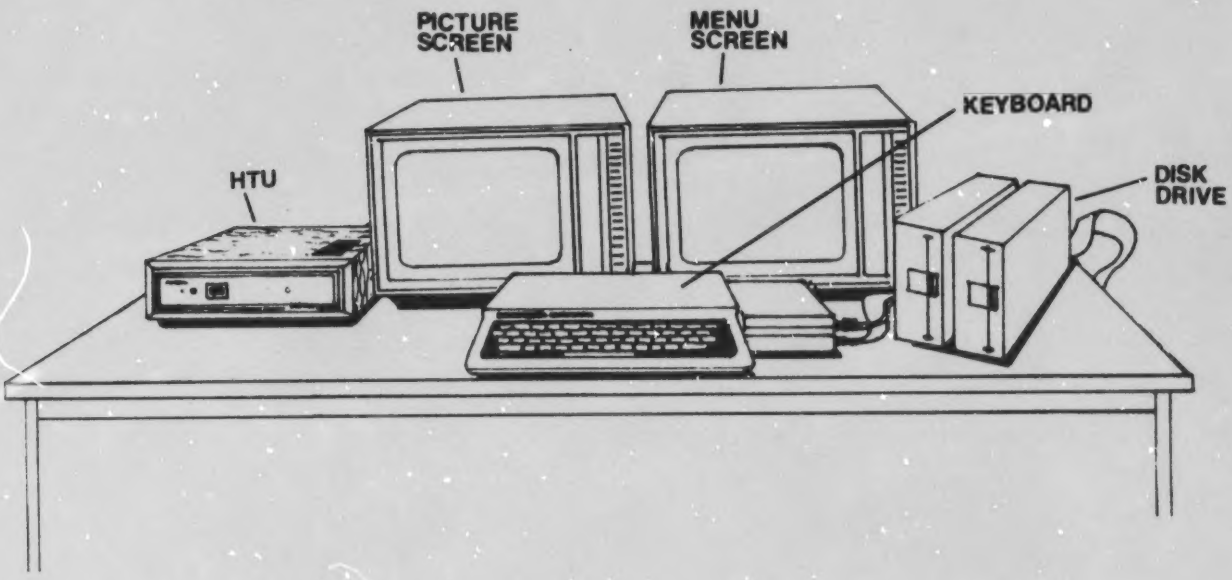
The IPS is equipped with an RS-232 interface for remote connection. This allows for the direct transfer of frames via phone line to the INDAX mainframe computer through use of a modem. Nebraska is using the Hayes Stack Modem 1200, which operates at either 1200 or 300 baud. Using another computer program developed by Cox, transfer is made on line by entering the "translated" frame name and an eleven-digit data base frame key.

RECALL OF COMPLETED INDAX FRAMES

VIEW is a Cox-developed software system which utilizes off-the-shelf Radio Shack TRS-80 Color Computer equipment and a modified Home Terminal Unit (INDAX converter). The function of VIEW is to display INDAX frames on a color television set exactly as they will appear on the user's screen. Frames may be recalled directly from the data base (phone line connection) or stored on floppy disk for recall at the user's convenience. The VIEW system requires a TRS-80 Color Computer

with 32K EXTENDED Color Basic, a color computer mini disk drive, a small black/white television for display of information required during its operation, a color television for the display of completed frames, a home terminal unit, a Hayes Stack Smart Modem, and a RS power strip or power-line filter with 6+ outlets (Figure 20).

Figure 20: VIEW System



It is advisable for the graphic designer to view all completed frames for several reasons. First, noticeable shifts of color from the IPS to INDAX may drastically change an image. As noted before, red will appear pink and dark yellow often inclines toward brown. Second, the selection of normal or reverse video for alphanumeric text color will not be visible to the designer on the IPS in its completed block form in either the building or translation process. As you recall, both normal and reverse video color selection change the background color of the block in which a character is inserted. However, this change is not visible until you see the completed frame on INDAX.

Third, placement within a pixel is very important in building an "error-free" frame. If an element (dot, line, rectangle, etc.) has been entered on the edge of a pixel rather than in the center, it could result in "pixel displacement" or the filling of an adjacent pixel. This displacement might not be visible in translation but will definitely be visible on VIEW.

Occasionally, a completed INDAX frame will have an "echo" line. An echo line appears as a narrow vertical line of highly contrasting color, usually the length of one or more blocks. This demarcation occurs most often on the right edge of a text string or when a change is made from text characters to graphic elements. (See Figure 21.) Its cause appears to be in the unevenness of the picture plane. The level of a text line is either higher or lower than the rest of the frame and therefore causes a reflection of light to appear at its edge.

One way of avoiding an echo line is to establish uniform margins for text. Usually such margins are achieved by pressing the space-bar to lay in blank text space to the right edge of the frame. Although the echo line may still appear, it is less noticeable if it appears along the extreme edge of the frame. If the designer has selected white normal text color, the change to black normal for text spacing after the last word in each line completely eliminates the echo. Where completion of a text line to the edge of the frame is not possible (as in a frame containing a graphic illustration on the right side of the text), the designer may be able to eliminate the echo line by placing a graphic element over it. Small squares or rectangles in the background color are most useful for this purpose.

Figure 21: Example of an Echo Line

The echo line is apparent at the right edge of a text string when a change is made from text characters to graphic elements.

CORRECTIONS

At this point, any major correction of a frame is done on the IPS. Major corrections might include radical changes in the shape of an illustration or placing a graphic element over an echo line. Any corrections made on the IPS, however, must also be run through the translation process and transferred once again to the head-end computer, which can be a time-consuming process.

Minor corrections such as typos or color adjustments are made on-line using a Tandem 6530 full screen terminal which is also used to input programming information. This terminal consists of a keyboard with 16 function keys and a CRT display screen (See Figure 22). A special software program called Screenbuild allows for direct interac-

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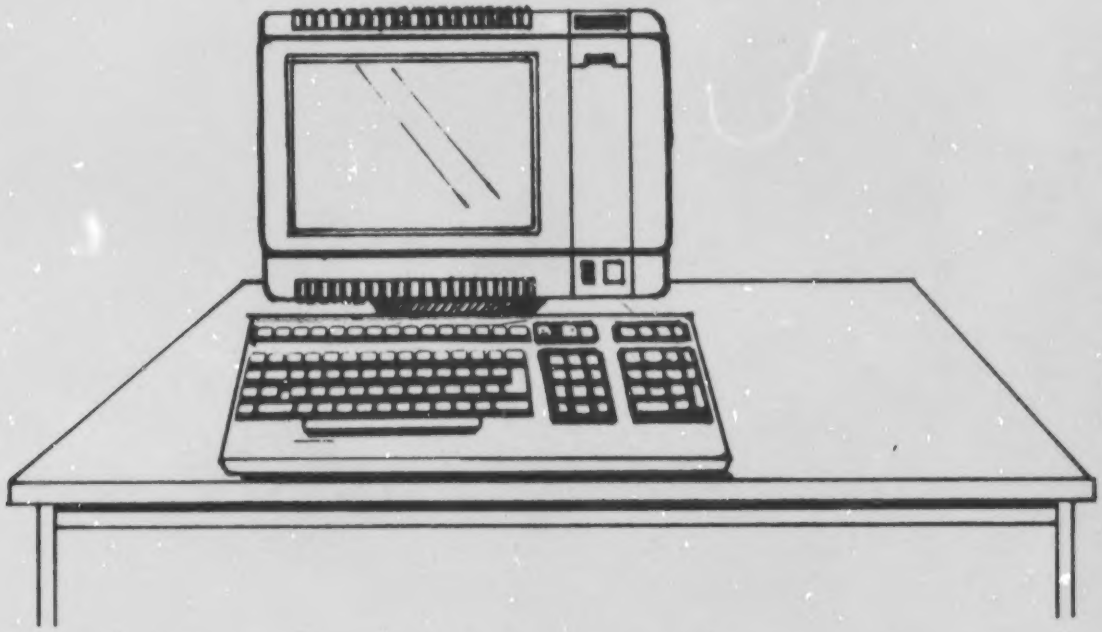
tion with the head-end computer, and corrected frames are placed instantly on the system. All graphic corrections on the Tandem 6530 must be made in semigraphic codes. Text edits are simply retyped.

Figure 22: Tandem 6530 Terminal



The Tandem 6530 terminal is used for on-line graphic corrections and to input programming information

FRAME DEVELOPMENT FOR OTHER VIDEOTEX SYSTEMS

Because there are no graphic standards, the difference between frame development on INDAX and that on other videotex systems is determined by the graphic capability of each. This difference is dependent on the resolution, which is determined by the number of pixels, the page size, the availability and use of color, and the total maximum per frame byte count.

As has been discussed, INDAX frames are alphamosaic in style, which makes the graphics "blocky" or "tile-shaped" in appearance.

Systems utilizing the alphageometric format allow for circles and arcs. This format generally denotes a higher resolution graphic, which is reflected in the larger page size (40 x 20 and 40 x 24 are both common) and the increased number of pixels. Usually these systems have fewer restrictions on the use of color. Often these restrictions depend on the total byte count per frame. INDAX limitations include the use of one color per block, and each color change requires approximately 2 bytes of memory.

Obviously, the equipment used to generate the graphics will also vary. In some instances, the designer will have access to a graphics tablet and/or camera to facilitate the development process. This also will depend on the system and its capabilities. In some cases, however, equipment for frame development is applicable to different systems. For instance, the Norpak unit used by the Nebraska staff produces alphageometric graphics appropriate for the Telidon system. As discussed in Chapter 5, however, careful design and software are needed to adapt graphics to the INDAX format.

When developing frames for other systems, these differences must be taken into account. With fewer restrictions, the designer can exercise greater flexibility of design.

CONCLUSIONS AND FRAME EXAMPLES

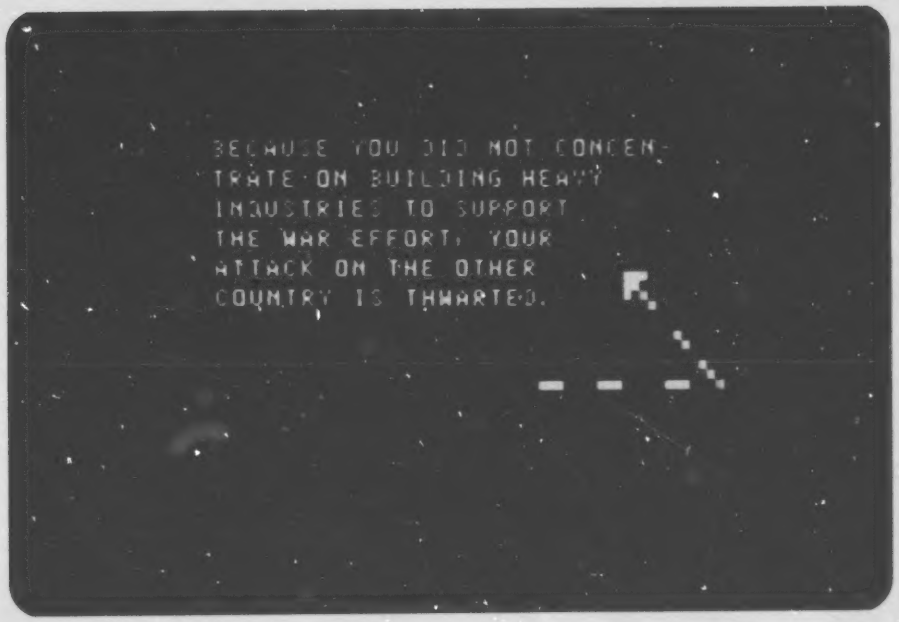
The fact that graphics can enhance instruction has been clearly demonstrated in the research (Rasco, Tennyson, & Boutwell, 1975; Peeck, 1974; Tennyson, 1978; Haring & Fry, 1979; Goldberg, 1974). Other work specifically with computer-based graphics has confirmed their importance, especially in helping students understand complex relationships (Bork, 1977). Despite its inherent instructional capa-

bilities, however, a graphic, by itself, can often convey many meanings and is not well suited to isolating details. Text can provide needed context and focus, and as the research shows, the two together can have a greater impact on learning than either used singly. In instructional contexts, emphasis should be placed on maximizing the interaction between pictorial and linguistic modes, using each to its best advantage to present concepts or facts.

The research also shows that because graphics can focus on critical elements and eliminate extraneous detail, in some instances they can be superior to realistic visuals (Dwyer, 1972). More abstract images convey a generic, conceptual meaning, while the specificity of a realistic picture may be delimiting. Perhaps some specific examples would emphasize this point. One of the INDAX segments developed by the Nebraska project was a college-level videotex simulation of Fascism, where the student is asked to assume the role of an aspiring Fascist leader and make decisions to build a Fascist state. For this instructional segment, realistic visuals would have given the exercise a time and place reality the design team was trying to avoid. In order for the student to suspend disbelief and project himself or herself into such an unlikely role, the visuals needed to be abstract and <u>suggest</u> environmental conditions and situations. In this case, the more abstract computer-generated visuals were superior to realistic visuals in achieving the objective (Figure 23).

Another videotex program is a Courtship Game which takes students from first date through marriage. Each student is presented with mate choices and several potential topics of conversation and activities for dates. Obviously, such a simulation can only approximate

Figure 23: Examples of Fascism Simulation Graphics



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Fascism Simulation Graphics (continued)

A PARTICULARLY IRATE GROUP OF
PURPLESHIRTS FINDS YOU AS YOU
ATTEMPT TO ESCAPE FROM THE
COUNTRY. AND YOU ARE SHOT ON
THE SPOT.

reality. It is general in nature, and the graphics need to be abstract. For example, full-frame graphic depictions of prospective mates were designed so that ethnic background is not obvious (Figure 24). They all have dark hair and dark eyes. The graphics suggest physical appearance; they do not provide great detail. If realistic photos or video had been used, extraneous variables would have been introduced. Students could have reacted negatively to some aspect of the mate's appearance or mannerism. By utilizing graphic depictions, this problem is avoided.

Graphics can provide a conceptual base or visual sense of what to expect from the text and can aid comprehension, but they can also add an interest factor. This motivational or interest factor has been verified in a number of videotex experiments where users have positively responded to the visual component (Montgomerie, 1982; Public Broadcasting Report, 1982; Goldman, et al., 1982).

Figure 24: Examples of Courtship Simulation Graphics

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Figure 24 (continued)

Graphic illustrations can enhance the appearance of a text frame and provide visual relief. Educational material is often highly verbal, requiring considerable text presentation. If a graphic can add an interest factor and increase a student's motivation to read the frames and work through the material, it has served a valuable function.

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Figure 25: Sample Frames from Nebraska Project

Comparative Modern Governments (Capitalism Simulation)

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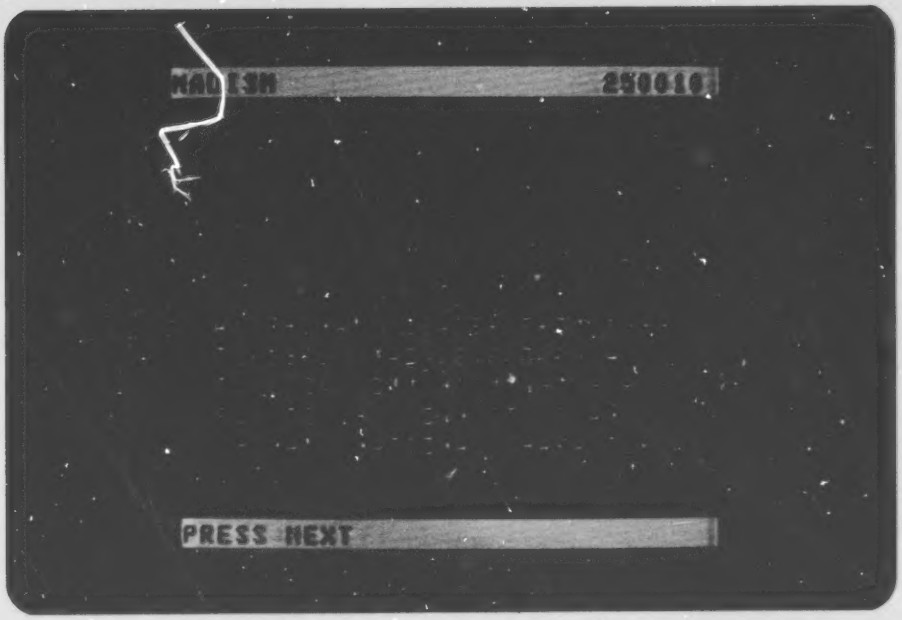

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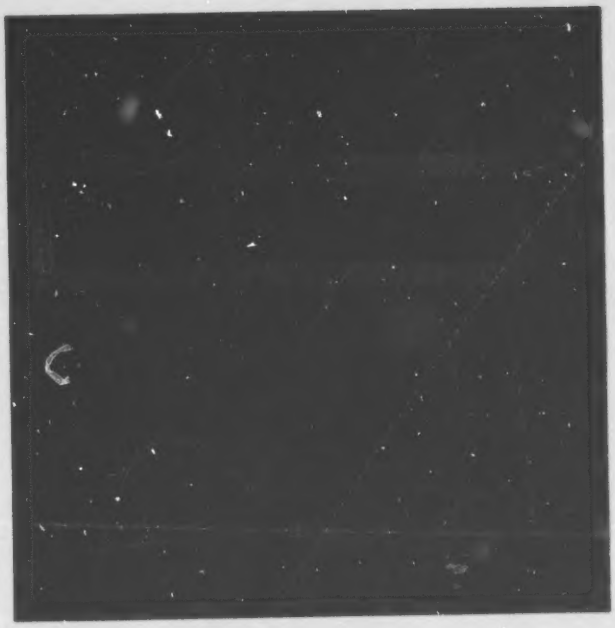
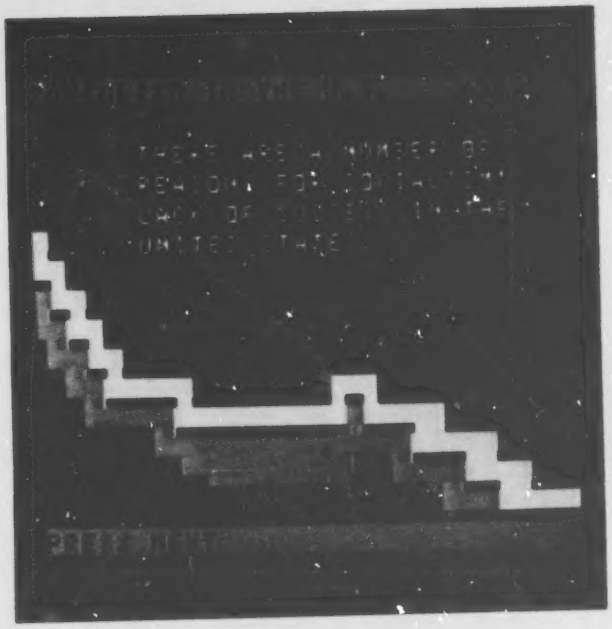
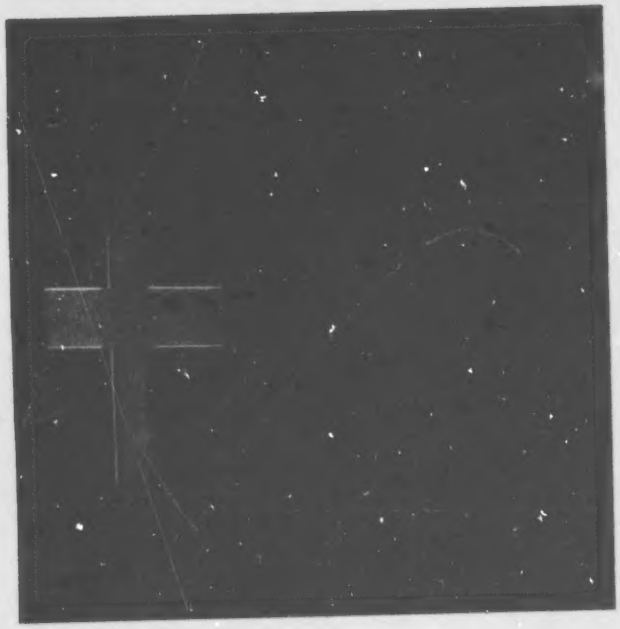
Comparative Modern Governments (Glossary)







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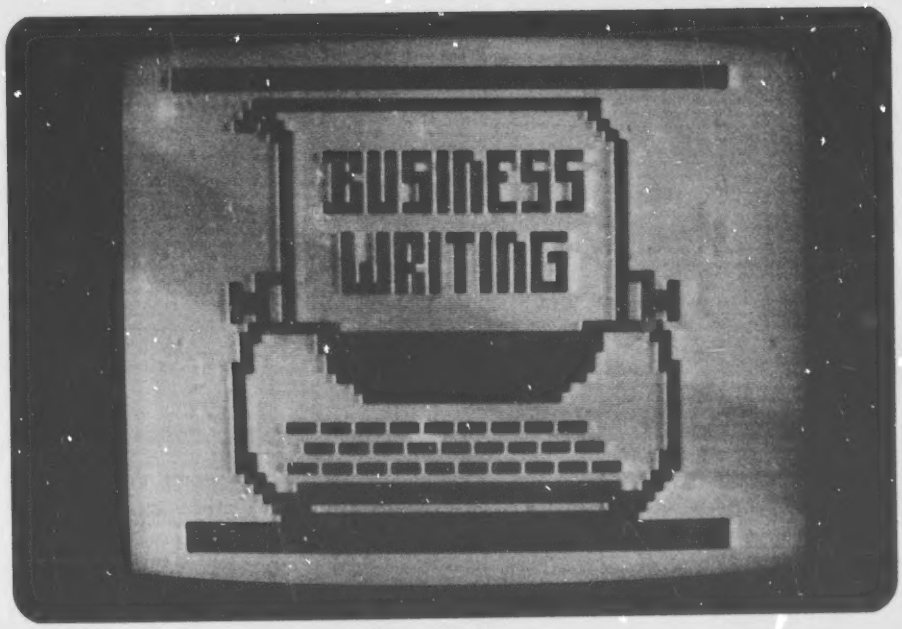

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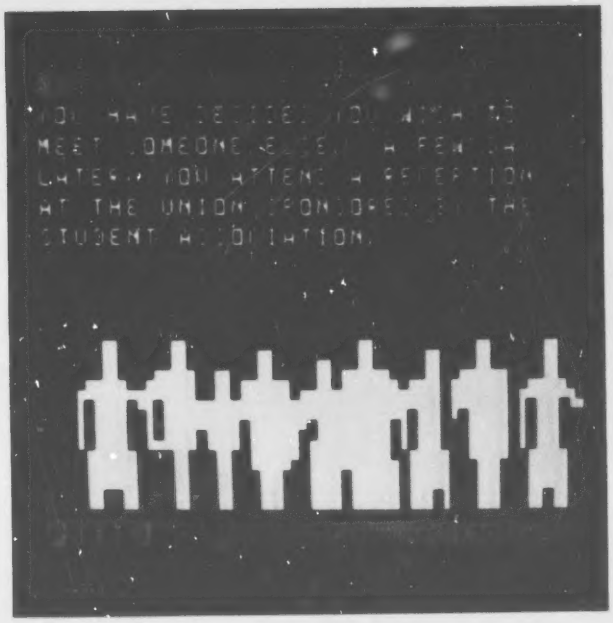
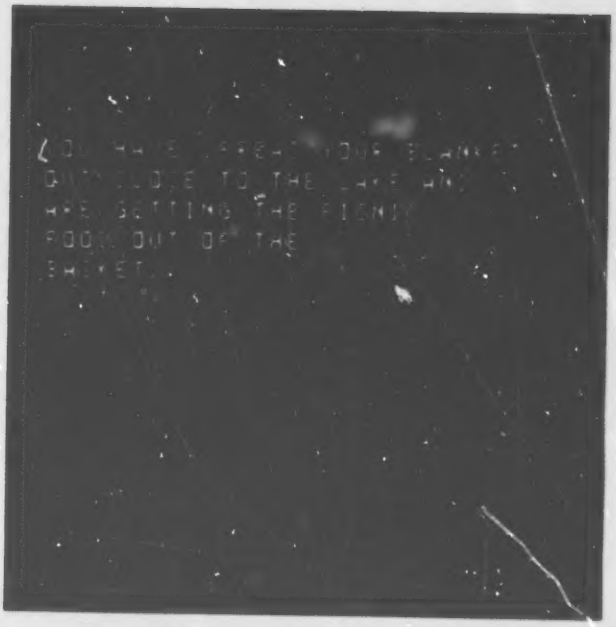
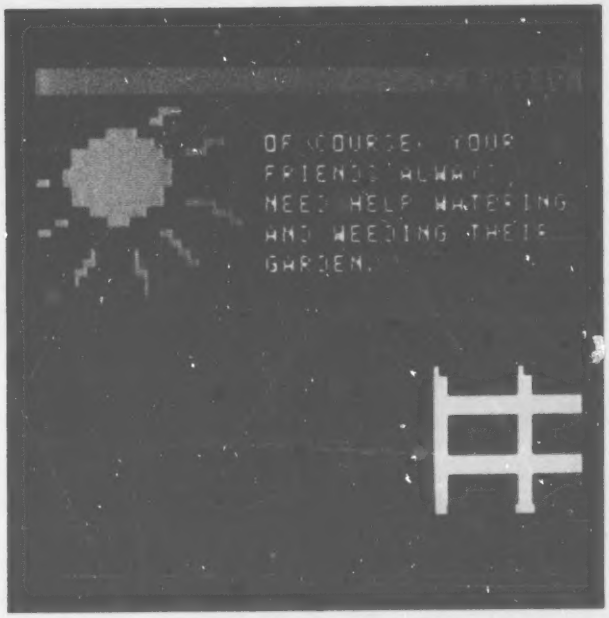
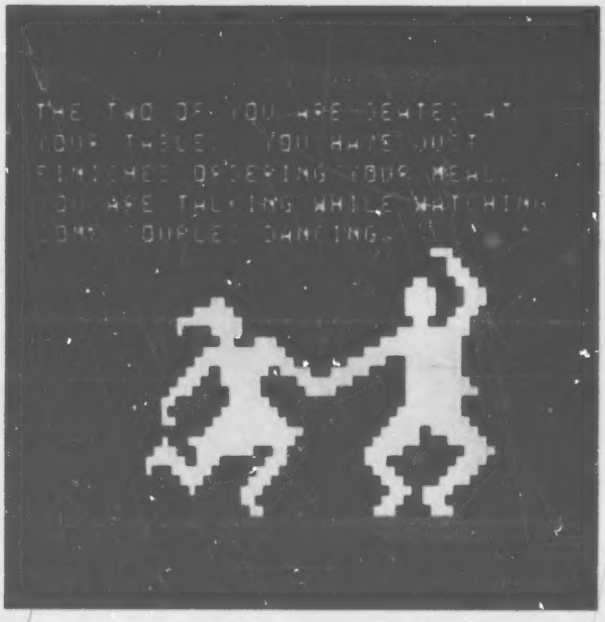
Marriage and the Family (Courtship Game)








THE TWO OF YOU ARE SEATED AT
YOUR TABLE. YOU HAVE JUST
FINISHED ORDERING YOUR MEAL.
YOU ARE TALKING WHILE WATCHING
SOME COUPLES DANCING.

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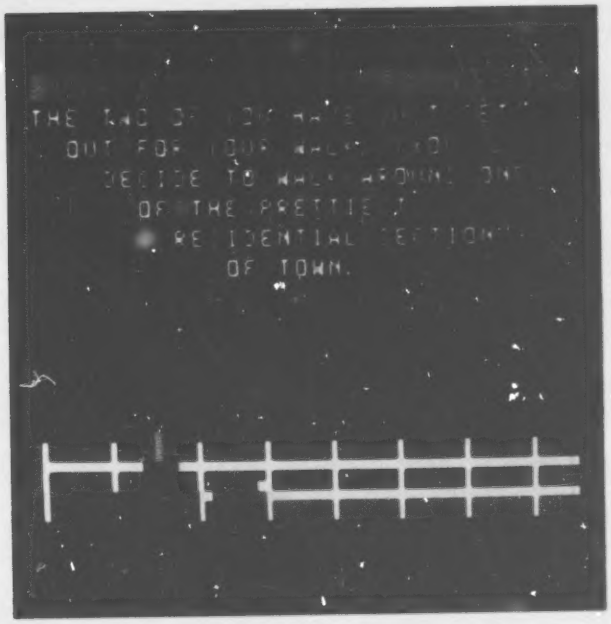
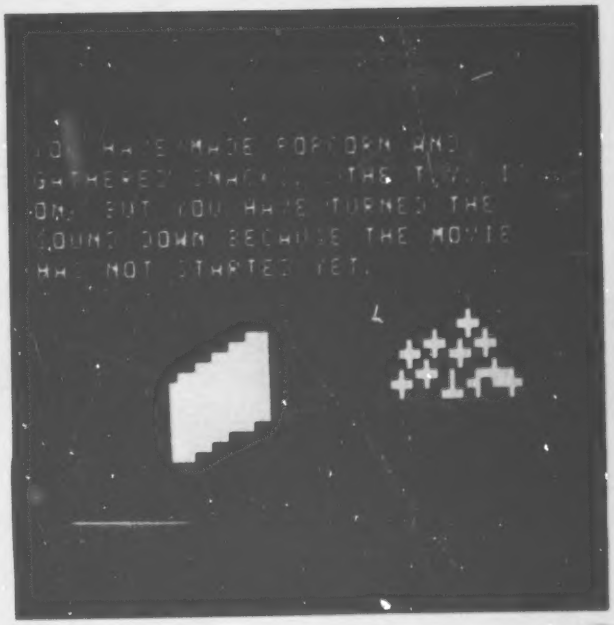
Marriage and the Family (Courtship Game)





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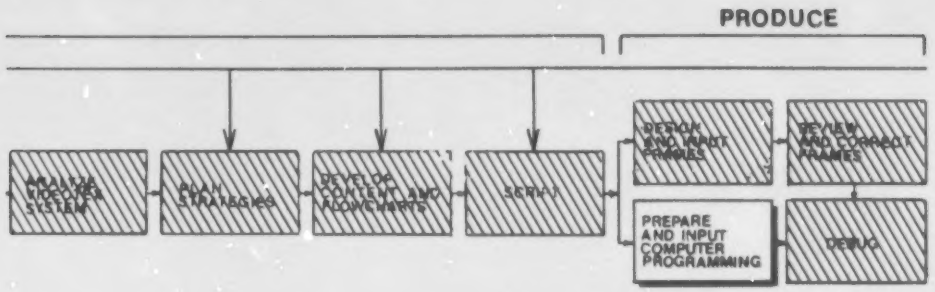
CHAPTER SIX

COMPUTER PROGRAMMING



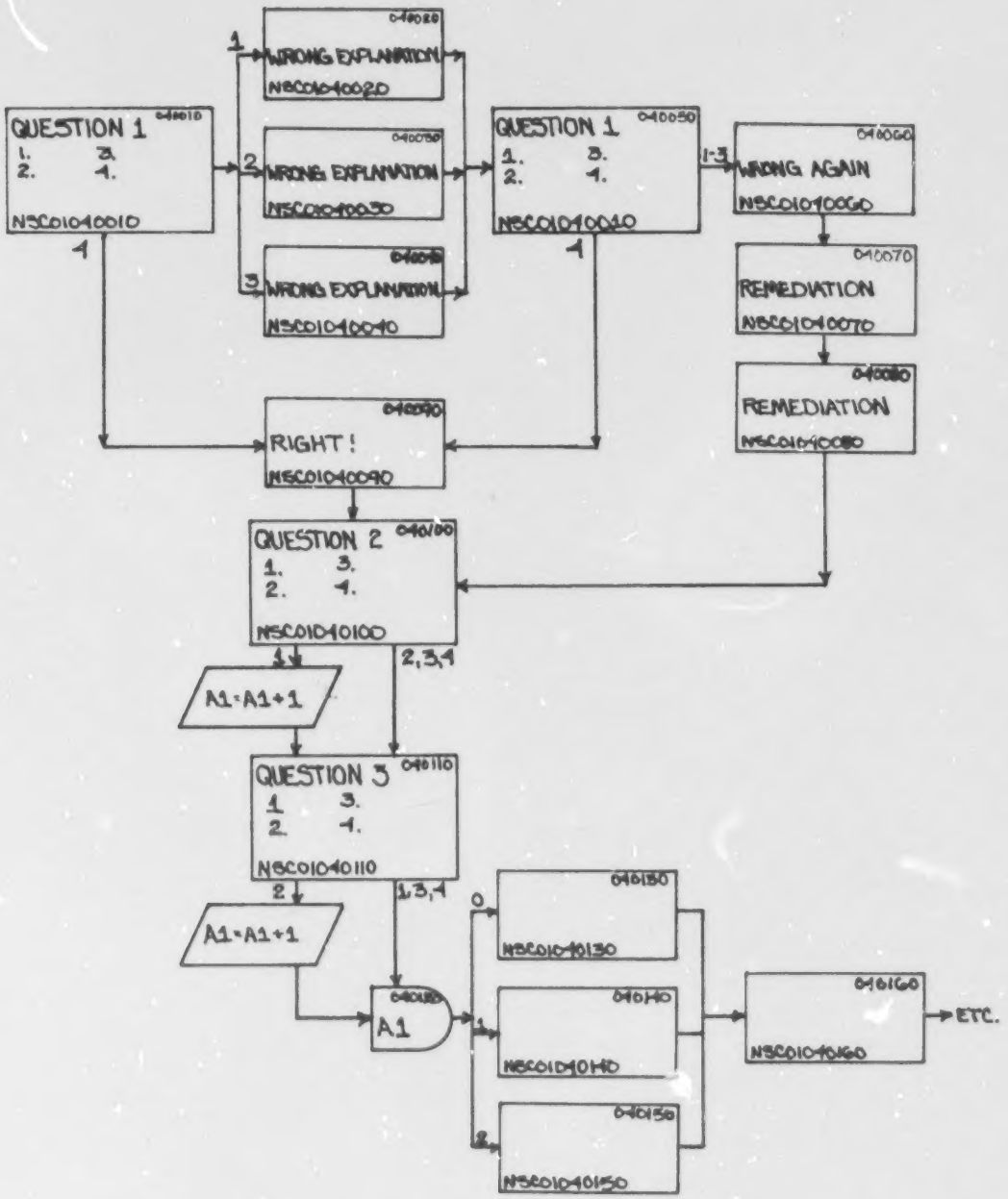
For the Nebraska Project the computer programming step has been greatly simplified through a basic authoring system co-developed by Cox-Atlanta and Nebraska for the two-way INDAX system. An authoring system incorporates instructional design elements into a readable form instead of a computer language. The authoring system was developed to computerize certain functions the Nebraska personnel thought necessary to provide effective computer-based instruction. These functions included branching requirements, response processing and record keeping, and session-to-session continuity. For example, it was felt that students should be able to return automatically to previous points in the instruction without having to "step back" through menus and decision points and that they should be able to move from one branch or track to another at any point. It was also critical that the computer could record and score student responses, store results in the system through several sessions, branch on the basis of accumulated scores or points and display these scores or points to the student. A detailed list of educational requirements was submitted to Cox, and the authoring system was developed to incorporate these requirements.

It should be noted that this authoring system is not as sophisticated as some of the more well-known programs, such as PILOT, and that not all desired functions could be built into the program. Nevertheless, it does allow someone unfamiliar with computer programming languages to enter specific programs for individual segments. It incorporates the instructional design elements into a readable form not hidden in a computer language code. To understand the authoring system, it is necessary to explain certain computer-related components or functions. First, each frame that will be displayed on the screen to the student is assigned a discrete 11-digit frame key number, and completed frames are placed on the INDAX system under the assigned number. When a particular frame in an instructional sequence is to be displayed, its frame number must be specified at the appropriate point in the branching program.

Another important component is a node. A node is used to distinguish a particular program step, and each box on the flowchart represents a node. Figure 26 shows a portion of a flowchart with node and frame keys noted. This flowchart is an example of computer functions; it does not represent an actual instructional sequence.

The number in the right-hand corner of each flowchart symbol is the node number, which must be six digits. The first two digits identify discrete instructional segments (1 to 50). Segment identification is usually necessary when an agency places several programs on the INDAX system. Figure 26 is an example of a discrete segment. All node numbers begin with 04 since each element relates to the same instructional program (#4). The remaining four digits represent the number previously assigned on the flowchart and script (with leading

Figure 26: Example of Flowchart with Node and Frame Keys Noted

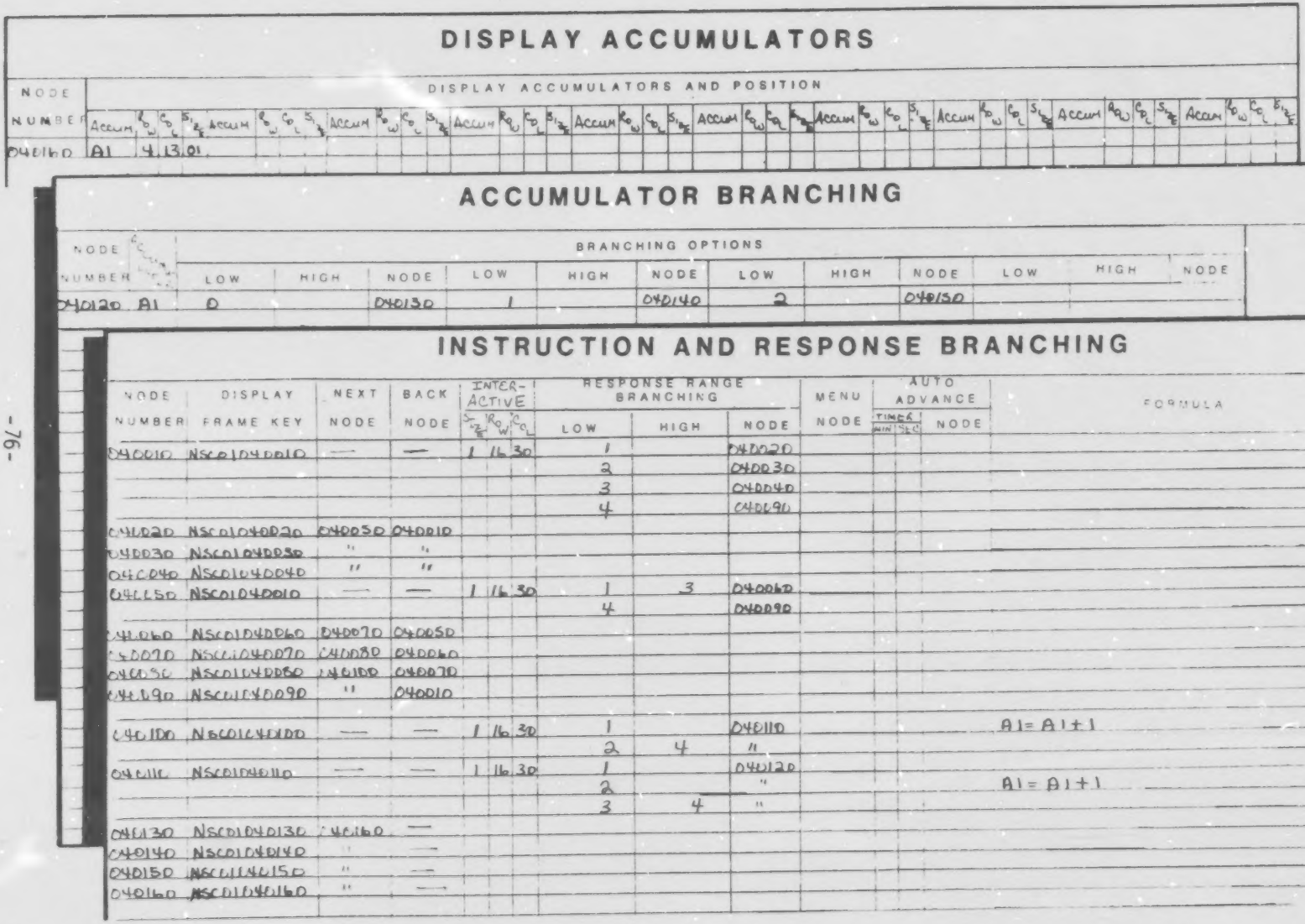


zeroes added). The eleven-digit number is the frame key, which uses the node number as the last six digits. (The first five digits are assigned based on INDAX and project specifications.) Because there are so many numbers involved in the process, confusion will be avoided if some system is developed to relate flowchart, script, node, and frame key numbers.

The information on this flowchart is entered on special forms (Figure 27), which were developed by Cox to organize data prior to input. As can be noted, branching information is entered by nodes. At each node on the instruction and response branching form, there are entries for the frame key to be displayed, the node where the student will advance if he/she presses the next, back, or menu function keys on the keypad, and where the student will be branched for numerical entries. If any of the function-related entries are left blank, a question mark will appear on the screen when the student depresses that key. Note that at node 040010, responses take students to different nodes. At 040050 three answers go to 040060, and the response range branching function on the forms is used. For numerical responses, the size of the response (number of digits) and placement where it should appear on the screen is required.

The auto advance column is used to display a frame for a specified number of seconds and automatically advance to the next frame. (There is no student response.) The formula column is used to note computations that should be executed at a particular node or program step.

Beginning with Node 040100, Figure 27 shows a section of a testing sequence where the number of correct answers is being tabulated in the



DISPLAY ACCUMULATORS

| NODE NUMBER | DISPLAY ACCUMULATORS AND POSITION | | |

formula column. The correct answer at node 040100 is 1, and A1 (storage point called an accumulator) is set at 1 (A1=A1+1). The correct answer at node 040110 is 2, and 1 is added to A1. If the student chooses an incorrect answer, A1 will not be incremented; it simply remains at its previous value. In this way the computer keeps a running total of the student's correct responses. To insure accuracy the user is not allowed to backtrack and reanswer a previous question. The student has only one chance to answer to prevent the cumulative total from becoming inflated.

The number of right answers can be displayed to the student at any time in the instructional sequence. For example, at node 040160 the student is presented with a frame saying, "You got ___responses correct." The computer automatically enters the accumulated value in the blank. The form used to record this step is called "Display Accumulators." The placement and size (number of digits) of the number on the screen is indicated.

Nodes 040120 to 040150 show a section with branching based on the value of the cumulative total A1 (accumulator branching). Notice that the information must be entered on two forms, an instruction and response branching form and an accumulator branching form.

One important aspect of the Cox-developed software package is the generation of text as part of the computer programming process instead of frame development/graphic design. Unfortunately, this capability was added to the authoring package late in the project year, when its full capability could not be incorporated into an in-place development process. The limited experience of the Nebraska project, however, has confirmed that it can greatly streamline the production process by

reducing the number of separate frames to be developed and placed on the system.

Developing text through the computer authoring system means that a generic frame or template incorporating needed visuals can be developed, and different text messages can be generated by the computer. One graphic frame, therefore, can be used repeatedly, with text changes made by the computer. Careful coordination is needed, however, to be sure that text information is appropriately placed on the frame. The row, column, and size must be entered on the form (Figure 28) and entry should reflect placement in relationship to the graphic.

Using the flowchart or branching information listed in the script, the appropriate data is entered on the forms. This information is then input directly into the computer using the authoring program. The authoring program is a menu-driven program initiated from a Tandem 6520/30 CRT terminal and input screens, which closely resemble the form format.

The authoring program prepared by Cox is clear and easy to operate. It has provisions for updating (for mistakes), displaying and deleting data. The entering of information from the forms is a simple process, and clerical personnel have been trained on the basic use of the program in approximately two hours.

One excellent feature of the authoring program is that once the information relating to a particular node has been recorded, the screen retains display of that information for entry of the subsequent node. This means that only the changes for the new node need to be

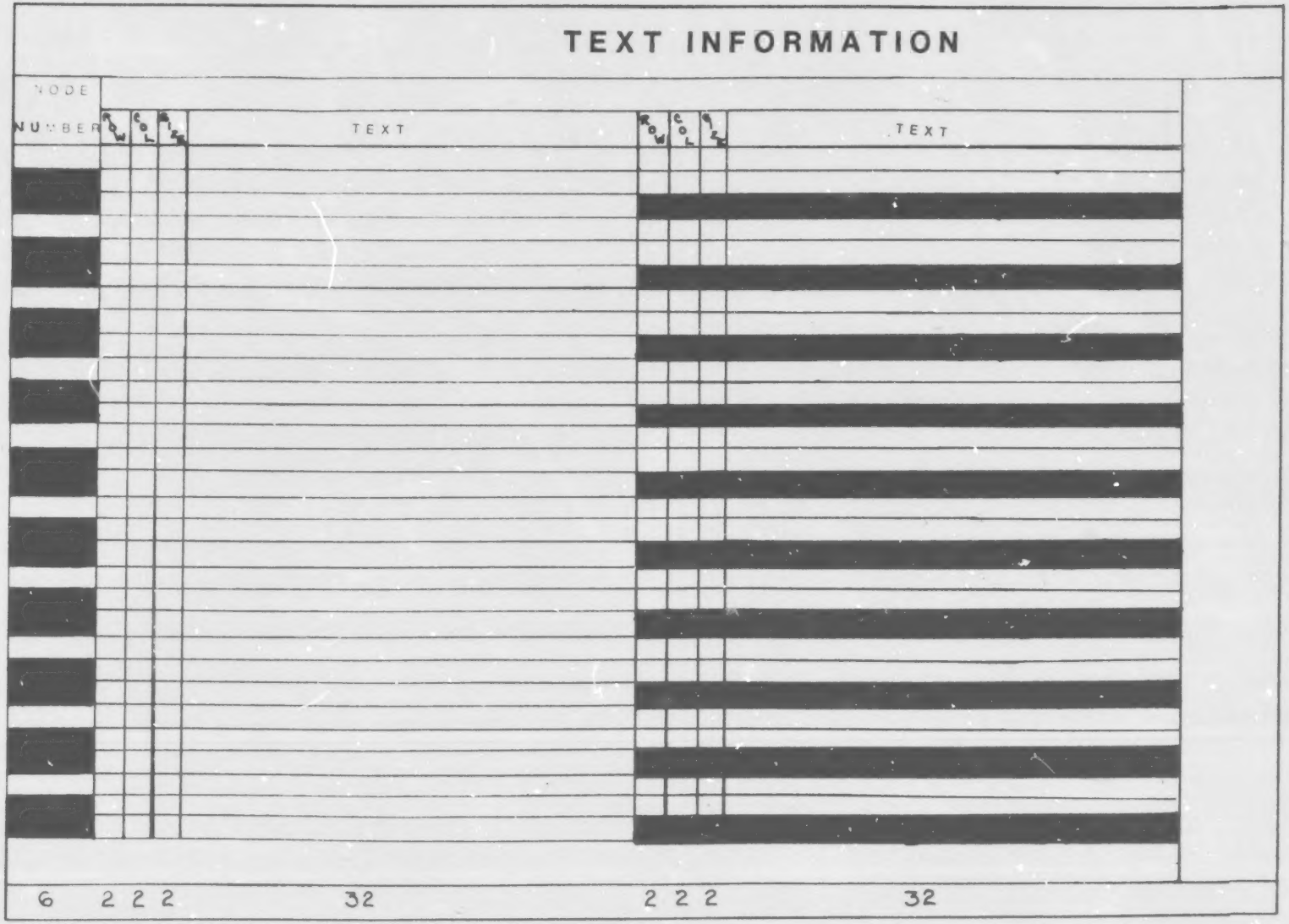


Figure 28: Form Used for Specification of Text Information

entered; the information does not have to be completely retyped. To input the data for the new node, the operator can use the forward advance key to move the cursor to a number that needs changing, enter the change, and advance to the next number that needs revision. This selective process can be an invaluable time saver when few changes are needed from node to node.

To capitalize on this feature, it is suggested that nodes with similar entries be listed together when preparing the forms. (For example, in Figure 27, there is a series of three frames from 040020 to 040040; all next-advance and back-advance to the same node.) Although this procedure may mean that the nodes do not appear on the forms in numerical order, the time saved in inputting can be well worth the effort.

Another consideration in completing the forms is to use some device to note when the same node, frame key, formula, etc. appear at subsequent steps. For example:

Node Number	Display Frame Key	Next	Back
010040	NPS01010040	010050	010030
010050	NPS01010050	010060	"

Obviously, if certain information stays the same across subsequent nodes, the operator can quickly forward-advance over that entry to the first needed change. Using a simple notation eliminates the need for scrutinizing long numbers to discern any changes from the previous node. It is also helpful to highlight changes on long, but similar, formulas that reoccur across several nodes. It is easy to note the change when completing the forms, and it will eliminate the need for

careful (and tedious) examination of the numbers when inputting.

Another obvious time saver is to input together all the decision frames requing a numerical response from the student. This procedure will allow the operator to set up the interactive response information (row, column, size, and numerical selections) once and simply make needed changes to node and frame key numbers.

Because of the many figures involved in program input, it is very easy to make a mistake. And, once a mistake has been made, it is difficult to spot. Data display via the Tandem terminal is by nodes; there is no way to list the entire program. To provide more compact listing of data, computer printouts of the branching information are available. The printouts allow cross-checking between data on the forms and data as entered to locate input errors.

CHAPTER SEVEN

TIME AND COST CONSIDERATIONS

INSTRUCTIONAL DESIGN TIME

Since the instructional design process for videotex is similar to that for computer-assisted instruction, time projections for the two should also be similar. Clearly, however, the amount of time required to design a computer or videotex lesson depends on several variables, including expertise of team members in preparing interactive instruction and the type and complexity of the computer materials.

Each of these two areas deserves comment. Ideally all team members would have had experience in preparing interactive instruction. Today's reality, however, is that finding a content person, scriptwriter, instructional designer, programmer, graphic designer, etc., who all have had such experience is highly unlikely. As a result, there will be some teaching and "growing" time to get all members up to speed. A key person in this process is the content consultant, because in most cases preparing the basic flowchart requires thorough content knowledge. Although the instructional designer and scriptwriter can and should have input, they cannot be expected to assume total responsibility. Experience has shown that a superior product results if all team members can be involved in developing the basic structure, but it should be kept in mind that development time is a function of total team expertise.

The second variable is the complexity of the computer material. Simple testing, drill and practice, and tutorial materials require

shorter development times than do complex games and simulations. There can also be tremendous variations in the complexity of simulations.

Given these parameters, Table 1 shows some general design time estimates for preparation of videotex segments for the Nebraska Videotex Project. Design time includes team meetings, content and flowchart development, scripting, formative evaluation, as well as necessary secretarial support.

Table 1: Instructional Design Time Estimates

Type of Instruction	Time Estimate
Tutorials (70 frame average)	40 hours
Testing sequence (185 frames average)	65 hours
Glossaries (70 frames)	40 hours
Simulations (135 frames)	150 hours
Complex simulations (860 frames)	1400 hours

In the table above, testing sequences refer to segments where the students are presented with a series of multiple choice questions and are provided feedback tailored to their response. After answering a single question incorrectly once or twice, they are given the correct answer and branched automatically to the next question. A tutorial is a segment teaching a particular concept or topic and utilizes many of the techniques of branched programmed instruction. Glossaries are definitions or explanations of key concepts. Simulations use the computer to model a real world experience. The simple simulations developed by the Nebraska Project were based on logic flows inherent in

the branching structure; no computations were involved. They also dealt with a restricted number and expansion of variables. On the other hand, the more complex simulations relied heavily on computations and involved a more in-depth treatment of the subject matter.

PRODUCTION TIME

Production activities include completion of the programming forms, inputting the programming using Cox's authoring system, design and input of the graphics, and debugging. In order to provide exact and comprehensive information, time breakdowns are reported for programming and frame development functions.

Programming

The complexity and length of the segments dictates the amount of time required to complete the forms and input the programming, as shown in Table 2.

Table 2: Programming Time Estimates

Type of Instruction	Forms	Program Input	Total
Tutorials (70 node average)	1½ hr.	1 hr.	2 1/2 hr.
Testing sequences (210 node average)	4 hr.	4 hr.	8 hr.
Glossaries (70 node average)	1 hr.	45 min.	1 3/4 hr
Simulations (175 node average)	4 hr.	4 hr.	8 hr.
Complex simulations (1250 nodes)	41 hrs.	37 hrs.	78 hrs.

It should be emphasized that preparing the forms and inputting the branching is not analogous to writing and entering a typical computer program. First, computer programs include screen display commands in addition to branching and scorekeeping information. Screen design in videotex development is an independent prccess, so programming is not as complex as that encountered in typical computer-assisted instruction development. Second, the programming is input using an authoring system, which greatly streamlines the process. If the information had to be entered in a computer programming language, time estimates would have been considerably higher.

Frame Development

Time requirements for instructional design and programming are directly related to the nature of the instructional sequence and its complexity in terms of branching and record keeping. In contrast, the time required for frame development is a function of the graphic requirements of individual frames. For example, frames where 50% or more of the frame fill is devoted to graphic display will require longer development time than all text frames. These frames usually incorporate complex color changes and require careful and accurate design before input. The following chart presents time estimates of various frame development functions.

Table 3: Frame Development Time Estimates

Function	Average Per Frame Estimate
Graphic Design	
Graphic of 50% or more frame fill	4 hours
Graphic of less than 50%	45 minutes
Frame Input/Building	
Graphic 50% or more	45 minutes
Graphic less than 50%	20 minutes
All text	8 minutes
Translation	1 minute
Placement on INDAX system (9600 baud)	10 seconds
Corrections/revisions *	
Graphic frames	15 minutes
Text frames	1 minute

* Graphic revisions are usually done off-line, requiring reworking on Norpak, retranslating and placing on system again. Text revisions, such as correcting spelling errors, are done on-line using Screenbuild program and the Tandem 6530 terminal.

OVERALL TIME ESTIMATES

Separate time estimates for design, frame development, and programming have been presented to provide the most precise information. In order to provide a comprehensive picture, however, total labor hours are projected for various types of instructional sequences.

Table 4: Total Videotex Development Time Estimates

Type of Instruction	Hours		
	Design	Production	Total
Tutorials (70 frames, all text)	40	13	53
Testing sequences (185 frames, 25% graphic)	65	95	160
Glossaries (70 frames, 95% graphic)	40	115	155
Simulations (135 frames, 30% graphic)	150	105	255
Complex simulations (860 frames. 30% graphic *)	1400	575	1975

*Graphics and textual information repeated.

An examination of these figures underscores several important factors. First, frame development time escalates dramatically with the addition of graphics. A comparison of production times for the two seventy-frame sequences above clearly illustrates this fact. The all-graphic sequence required nine times more hours in production time than the all-text segment, and this difference was directly attributable to the visual augmentation.

Another interesting point is the relationship between design and production hours. Some authors have asserted that in the field of communication technology the design efforts require greater time and effort than the production aspects (Anadam & Kelly, 1982). The figures from this project point out that such a statement is too broad a generalization. The relationship between design and production time is dependent on the nature of the instructional sequence, the complexity of the branching, and the graphic requirements.

PRODUCTION COSTS

The Nebraska Project was fortunate in that much of the equipment needed for frame development and programming input was provided free of charge by Cox Cable. Cox placed at the Lincoln facility a Norpak Information Provider System ($20,000*) and a Tandem 6530 full screen terminal ($3,000). Phone line connection to the main computer in Cox's Omaha facility is through use of a modem. Nebraska is using the Hayes Stack Modem, which costs $575.

*All cost figures are based on January 1, 1983 prices.

GLOSSARY

Accumulator - Storage point for student's numerical entries in INDAX's two-way interactive system.

Alphageometric - Videotex/teletext graphic construction and presentation mode where visuals are assembled from computer-stored geometric patterns, such as polygons, circles, and arcs.

Alphamosaic - Videotex/teletext graphic construction and presentation mode where visuals appear as if constructed of individual tiles.

Alphanumeric Text - The upper case letters, numerals 0-9, and 27 special characters available on INDAX. Each character utilizes one block.

Analogous Colors - Those colors of the same family and next to each other on the color wheel (greens/blues, reds/oranges).

Antiope - French teletext system.

Authoring System - A system that incorporates instructional design elements into a readable form instead of a computer language. It allows someone unfamiliar with computer programming to write a computer program in English.

Byte - Basic unit of information in a computer, commonly consisting of 8 binary bits. One byte usually represents one character.

Color Coding - Changing text color to structure data. This allows for emphasis on words or phrases and contrast between similar data.

Display Text - Any text which is larger than one block and developed on a pixel-by-pixel basis.

Frame Key - Eleven-digit INDAX database frame number.

Function Key - Keypad or keyboard button dedicated to a specific function.

Home Terminal Unit (HTU) - INDAX converter/decoder.

INDAX - Two-way cable system developed by Cox Cable.

IPS - The Information Provider System manufactured by Norpak used to generate computer graphics.

Matrix Board - Specially prepared form that accurately reflects the block and pixel arrangement in an INDAX frame. It is used by the graphic designer for layout.

Menu - A computer-displayed index requiring a choice from the user.

Modem - Device permitting computers and terminals to communicate via phone lines.

Node - Program step in INDAX's two-way interactive system. Usually each symbol on a flowchart corresponds to a node.

Normal Video Text - Color selection to specify the alphanumeric text color.

Pixel - Short for picture element, the smallest design unit. There are six pixels of equal size in every block.

Prestel - Videotex system developed in Britain that uses phone line transmission.

QUBE - Two-way cable system developed by Warner Amex Cable Communications.

Resolution - Description of the density and overall quality of a TV display.

Reverse Video Text - Color selection to specify the block color behind the alaphanumeric text.

Spatial Coding - Spacing between text lines to alleviate text density, promote clarity of message, and give visual relief to the viewer.

Teletext - Elecronic delivery system that transmits text and graphic information via the vertical blanking interval of a TV signal.

Telidon - Videotex/teletext technology developed in Canada. Telidon is both a graphics protocol and a videotex system.

Template - Generic frame containing all graphic elements that can be used with different text messages.

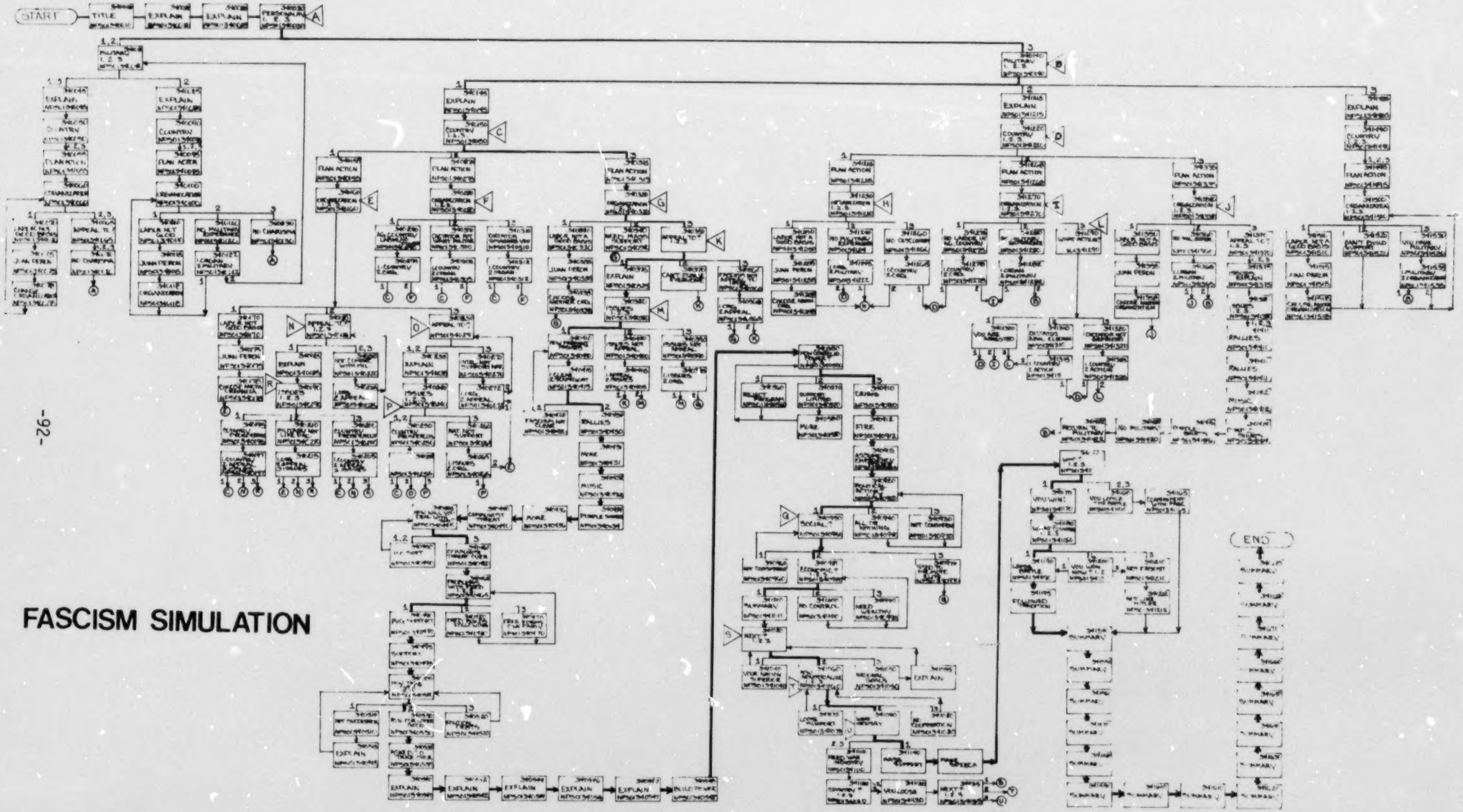
Vertical Blanking Interval - Unused portion of a TV signal used to send closed captions, test data, or teletext information (more commonly known as "the black roll bar").

Videotex - Two-way electronic system generally using coaxial cable or phone lines for delivery of text and graphic information.

APPENDIX A

SECTION OF A FLOWCHART FROM

THE NEBRASKA PROJECT


START
TITLE
EXPLAIN
EXPLAIN
PERSONALITY
EXPLAIN
COUNTRY
PLAN ACTION
ORGANIZATION
EXPLAIN
MILITARY
EXPLAIN
COUNTRY
PLAN ACTION
ORGANIZATION

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